TECHNICAL BULLETIN No. 20

Oregon State Highway Department

R. H. BALDOCK, State Highway Engineer

STANDARD HIGHWAY SPIRAL

By

H. W. LIBBY
Chief Locating Engineer

Published by

OREGON STATE HIGHWAY COMMISSION
SALEM

T. H. BANFIELD, Chairman
BEN R. CHANDLER, Commissioner
CHAS. H. REYNOLDS, Commissioner

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THE STANDARD HIGHWAY SPIRAL
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THE STANDARD HIGHWAY SPIRAL NOTATION

P. T. = Point of change in alignment from spiral to tangent.

P. S. = Point of change from tangent to spiral.

P. S. C. = Point of change from spiral to circular curve.

P. C. S. = Point of change from circular curve to spiral.

P. R. S. = Point of reverse spirals.

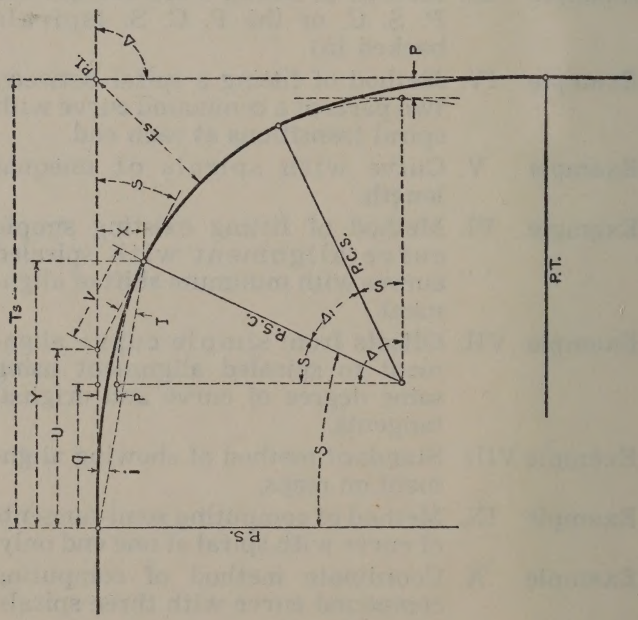
P. S. S. = Point of change from increasing to decreasing spiral.

P. O. S. = Point on spiral.

P. O. C. = Point on circular curve.

P. O. S. T. = Point on semi-tangent.

P. O. T. = Point on tangent.



U = The distance on the tangent from the P. S. to the intersection with a tangent through the P. S. C.; the longer spiral tangent.

V = The distance on the tangent through the P. S. C. from the P. S. C. to the intersection with the tangent through the P. S.; the shorter spiral tangent.

Y = The abscissa or tangent distance of the P. S. C., referred to the P. S.

X = The ordinate or tangent offset of the P. S. C.

q = The distance measured along the main tangent from P. S. or P. T. to a point where the circular curve produced backward or forward becomes parallel to the main tangent.

Δ = The total central angle of the curve.

s = The central angle of the spiral from the P. S. to any given point.

S = The central angle of the whole spiral.

Ts = The tangent distance of the spiraled curve; distance from the P. S. to the P. I.

Δ_1 = $\Delta - 2S$ = Total central angle minus the sum of the central angles of the spirals.

i = The angle between the tangent at the P. S. and the chord from the P. S. to any point on the spiral or the deflection angle to any point on the spiral.

I = The angle at any point on the spiral between the tangent at that point and the chord from the P. S.

C = The chord from the P. S. to the P. S. C.

d = The degree of curve at any point on the spiral.

D = The degree of the central circular curve.

Es = External of spiraled curve.

a = The increase in degree of curve per station on the spiral = $\frac{D}{L}$.

p = The offset from the main tangents to the point where the circular curve produced backward or forward becomes parallel to the main tangent.

R = The radius of the central circular curve.

l = The length of the spiral from the P. S. to any given point.

L = The length of the spiral from the P. S. to the P. S. C.

THE STANDARD HIGHWAY SPIRAL
BASIC FORMULA

Spiral Definition

The Standard Highway Spiral is a curve whose degree varies directly as its length, beginning at zero at the P. S. and reaching a degree of curve equal to the simple curve at the P. S. C.

$$\left.\begin{aligned} a &= \frac{100\,D}{L}, \quad D = \frac{a\,L}{100}, \\ L &= \frac{100\,D}{a} \\ S^\circ &= \frac{D\,L}{200}, \quad D = \frac{200\,S^\circ}{L}, \\ L &= \frac{200\,S^\circ}{D} \end{aligned}\right\} \quad S = \frac{a\,L^2}{20{,}000} = \frac{D^2}{100\,a}$$

$$R = \frac{5729.5779513}{D} = \frac{5729.5779513L}{200\,S^\circ} = \frac{28.647889757L}{S^\circ}$$

θ = S in Radians

$$X = L\left(\frac{\theta}{3} - \frac{\theta^3}{42} + \frac{\theta^5}{1320} - \frac{\theta^7}{75{,}600} + \frac{\theta^9}{6{,}894{,}720} - \frac{\theta^{11}}{918{,}086{,}400} + \frac{\theta^{13}}{168{,}129{,}561{,}600} - \frac{\theta^{15}}{40{,}537{,}905{,}408{,}000} - \cdots\right)$$

$$Y = L\left(1 - \frac{\theta^2}{10} + \frac{\theta^4}{216} - \frac{\theta^6}{9360} + \frac{\theta^8}{685{,}440} - \frac{\theta^{10}}{76{,}204{,}800} + \frac{\theta^{12}}{11{,}975{,}040{,}000} - \frac{\theta^{14}}{2{,}528{,}170{,}444{,}800} - \cdots\right)$$

$$\text{Tan } i = \frac{X}{Y}$$

$$I = S - i$$

$$p = X - R \text{ vers } S = X - \frac{28.64788957\ L}{S^\circ} \text{ vers } S$$

$$q = Y - R \sin S = Y - \frac{28.64788957\ L}{S^\circ} \sin S$$

$$U = Y - X \cot S$$

$$V = \frac{X}{\sin S} = X \csc S$$

$$C = \sqrt{X^2 + Y^2}$$

$$Ts = (R + p) \tan \frac{\Delta}{2} + q$$

$$Es = (R + p) \text{ exsec } \frac{\Delta}{2} + p$$

$\pi = 3.1415926536$

The foregoing formulae for p, q, U and V, will not give consistent answers when S is less than 3° 00′ because the tables available do not have enough significant figures.

OFFSET SPIRALS

L^1, X^1, and Y^1 = Length and coordinates of offset spiral

O = Distance offset

θ = S in Radians

$L^1 = L \pm O\theta$

$X^1 = X + O\ (1 - \cos S)$ (Outside)

$X^1 = X + O\ (\cos S - 1)$ (Inside)

$Y^1 = Y + O \sin S$ (Outside)

$Y^1 = Y - O \sin S$ (Inside)

The deflection angles will be approximately the same for L^1 as for L.

THE STANDARD HIGHWAY SPIRAL

SPIRALS

All curves shall be spiraled, using the Talbot Spiral based on the arc definition for radius of curve. The standard length for spirals shall be as follows:

Degree of Curve	Value of "a"	Length
0° 15′	0.1	250′
0° 16′ to 0° 29′	0.1	Variable in proportion to degree
0° 30′	0.2	250′
0° 31′ to 0° 59′	0.2	
1° 00′	0.25	400′
1° 01′ to 1° 29′	0.25	
1° 30′	0.4	375′
1° 31′ to 1° 59′	0.4	
2° 00′	0.5	400′
2° 01′ to 2° 59′	0.5	
3° 00′	0.5	600′
3° 01′ to 3° 29′	0.6	
3° 30′	0.7	500′
3° 31′ to 3° 59′	0.7	
4° 00′	0.8	500′
4° 01′ to 4° 59′	0.8	
5° 00′	1.0	500′
5° 01′ to 5° 59′	1.0	
6° 00′	1 ⅓	450′
6° 01′ to 6° 59′	1 ⅓	
7° 00′	1.75	400′
7° 01′ to 7° 59′	1.75	
8° 00′	2.0	400′
8° 01′ to 9° 59′	2.0	
10° 00′	2.5	400′
10° 01′ to 11° 59′	2.5	
12° 00′	3.0	400′
12° 01′ to 13° 59′	3.5	
14° 00′	4.0	350′
14° 01′ to 15° 59′	4.0	
16° 00′	5.0	320′
16° 01′ to 17° 59′	5.0	
18° 00′	6.0	300′
18° 01′ to 19° 59′	6.0	
20° 00′	8.0	250′
20° 01′ to 23° 59′	8.0	
24° 00′	10.0	240′
24° 01′ to 29° 59′	10.0	
30° 00′	15.0	200′
30° 01′ to 35° 59′	15.0	
36° 00′	20.0	180′
36° 01′ to 39° 59′	20.0	
40° 00′	25.0	160′
Above 40°	25.0	

TABLE I

Radii, deflection angles and chord corrections for circular curves of "arc" definition.

N. B.—The radius of a one degree curve is 5,729.57795+ feet. To find the radii for other degree curves, divide the foregoing radius by the desired degree of curve.

TABLE I, RADII, DEFL., AND CHORDS, ARC DEFINITION

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
0.10°	57,295.78	00.030	0° 00.750	00° 01.50	25.00	50.00	100.00
0.20	28,647.89	00.060	0° 01.500	00° 03.00	25.00	50.00	100.00
0.30	19,098.59	00.090	0° 02.250	00° 04.50	25.00	50.00	100.00
0.40	14,323.94	00.120	0° 03.000	00° 06.00	25.00	50.00	100.00
0.50	11,459.16	00.150	0° 03.750	00° 07.50	25.00	50.00	100.00
0.60	9,549.30	00.180	0° 04.500	00° 09.00	25.00	50.00	100.00
0.70	8,185.11	00.210	0° 05.250	00° 10.50	25.00	50.00	100.00
0.80	7,161.97	00.240	0° 06.000	00° 12.00	25.00	50.00	100.00
0.90	6,366.20	00.270	0° 06.750	00° 13.50	25.00	50.00	100.00
1.00	5,729.58	00.300	0° 07.500	00° 15.00	25.00	50.00	100.00
1.10	5,208.71	00.330	0° 08.250	00° 16.50	25.00	50.00	100.00
1.20	4,774.65	00.360	0° 09.000	00° 18.00	25.00	50.00	100.00
1.30	4,407.37	00.390	0° 09.750	00° 19.50	25.00	50.00	100.00
1.40	4,092.56	00.420	0° 10.500	00° 21.00	25.00	50.00	100.00
1.50	3,819.72	00.450	0° 11.250	00° 22.50	25.00	50.00	100.00
1.60	3,580.99	00.480	0° 12.000	00° 24.00	25.00	50.00	100.00
1.70	3,370.34	00.510	0° 12.750	00° 25.50	25.00	50.00	100.00
1.80	3,183.10	00.540	0° 13.500	00° 27.00	25.00	50.00	100.00
1.90	3,015.57	00.570	0° 14.250	00° 28.50	25.00	50.00	100.00
2.00	2,864.79	00.600	0° 15.000	00° 30.00	25.00	50.00	100.00
2.10	2,728.37	00.630	0° 15.750	00° 31.50	25.00	50.00	99.99
2.20	2,604.35	00.660	0° 16.500	00° 33.00	25.00	50.00	99.99
2.30	2,491.12	00.690	0° 17.250	00° 34.50	25.00	50.00	99.99
2.40	2,387.32	00.720	0° 18.000	00° 36.00	25.00	50.00	99.99
2.50	2,291.83	00.750	0° 18.750	00° 37.50	25.00	50.00	99.99
2.60	2,203.68	00.780	0° 19.500	00° 39.00	25.00	50.00	99.99
2.70	2,122.07	00.810	0° 20.250	00° 40.50	25.00	50.00	99.99
2.70	2,122.07	00.810	0° 20.250	00° 40.50	25.00	50.00	99.99
2.90	1,975.72	00.870	0° 21.750	00° 43.50	25.00	50.00	99.99
3.00	1,909.86	00.900	0° 22.500	00° 45.00	25.00	50.00	99.99
3.10	1,848.25	00.930	0° 23.250	00° 46.50	25.00	50.00	99.99
3.20	1,790.49	00.960	0° 24.000	00° 48.00	25.00	50.00	99.99
3.30	1,736.24	00.990	0° 24.750	00° 49.50	25.00	50.00	99.99
3.40	1,685.17	01.020	0° 25.500	00° 51.00	25.00	50.00	99.99
3.50	1,637.02	01.050	0° 26.250	00° 52.50	25.00	50.00	99.99
3.60	1,591.55	01.080	0° 27.000	00° 54.00	25.00	50.00	99.98
3.70	1,548.53	01.110	0° 27.750	00° 55.50	25.00	50.00	99.98
3.80	1,507.78	01.140	0° 28.500	00° 57.00	25.00	50.00	99.98
3.90	1,469.12	01.170	0° 29.250	00° 58.50	25.00	50.00	99.98
4.00	1,432.39	01.200	0° 30.000	01° 00.00	25.00	50.00	99.98
4.25	1,348.14	01.275	0° 31.875	01° 03.75	25.00	50.00	99.98
4.50	1,273.24	01.350	0° 33.750	01° 07.50	25.00	50.00	99.98
4.75	1,206.23	01.425	0° 35.625	01° 11.25	25.00	50.00	99.97
5.00	1,145.92	01.500	0° 37.500	01° 15.00	25.00	50.00	99.97
5.25	1,091.35	01.575	0° 39.375	01° 18.75	25.00	50.00	99.97
5.50	1,041.74	01.650	0° 41.250	01° 22.50	25.00	50.00	99.97
5.75	996.45	01.725	0° 43.125	01° 26.25	25.00	50.00	99.96
6.00	954.93	01.800	0° 45.000	01° 30.00	25.00	50.00	99.96
6.25	916.73	01.875	0° 46.875	01° 33.75	25.00	50.00	99.96

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
6.50	881.47	01.950	0° 48.750	01° 37.50	25.00	50.00	99.95
6.75	848.83	02.025	0° 50.625	01° 41.25	25.00	50.00	99.95
7.00	818.51	02.100	0° 52.500	01° 45.00	25.00	49.99	99.94
7.25	790.29	02.175	0° 54.375	01° 48.75	25.00	49.99	99.94
7.50	763.94	02.250	0° 56.250	01° 52.50	25.00	49.99	99.93
7.75	739.30	02.325	0° 58.125	01° 56.25	25.00	49.99	99.93
8.00	716.20	02.400	1° 00.000	02° 00.00	25.00	49.99	99.92
8.25	694.49	02.475	1° 01.875	02° 03.75	25.00	49.99	99.92
8.50	674.07	02.550	1° 03.750	02° 07.50	25.00	49.99	99.91
8.75	654.81	02.625	1° 05.625	02° 11.25	25.00	49.99	99.91
9.00	636.62	02.700	1° 07.500	02° 15.00	25.00	49.99	99.90
9.25	619.41	02.775	1° 09.375	02° 18.75	25.00	49.99	99.90
9.50	603.11	02.850	1° 11.250	02° 22.50	25.00	49.99	99.89
9.75	587.65	02.925	1° 13.125	02° 26.25	25.00	49.98	99.89
10.00	572.96	03.000	1° 15.000	02° 30.00	25.00	49.98	99.88
10.50	545.67	03.150	1° 18.750	02° 37.50	25.00	49.98	99.87
11.00	520.87	03.300	1° 22.500	02° 45.00	25.00	49.98	99.85
11.50	498.22	03.450	1° 26.250	02° 52.50	25.00	49.98	99.83
12.00	477.46	03.600	1° 30.000	03° 00.00	25.00	49.98	99.82
12.50	458.37	03.750	1° 33.750	03° 07.50	25.00	49.97	99.80
13.00	440.74	03.900	1° 37.500	03° 15.00	25.00	49.97	99.78
13.50	424.41	04.050	1° 41.250	03° 22.50	25.00	49.97	99.76
14.00	409.26	04.200	1° 45.000	03° 30.00	25.00	49.97	99.75
14.50	395.14	04.350	1° 48.750	03° 37.50	25.00	49.96	99.73
15.00	381.97	04.500	1° 52.500	03° 45.00	24.99	49.96	99.72
15.50	369.65	04.650	1° 56.250	03° 52.50	24.99	49.96	99.70
16.00	358.10	04.800	2° 00.000	04° 00.00	24.99	49.96	99.67
16.50	347.25	04.950	2° 03.750	04° 07.50	24.99	49.95	99.65
17.00	337.03	05.100	2° 07.500	04° 15.00	24.99	49.95	99.63
17.50	327.40	05.250	2° 11.250	04° 22.50	24.99	49.95	99.60
18.00	318.31	05.400	2° 15.000	04° 30.00	24.99	49.95	99.57
18.50	309.71	05.550	2° 18.750	04° 37.50	24.99	49.94	99.55
19.00	301.56	05.700	2° 22.500	04° 45.00	24.99	49.94	99.53
19.50	293.82	05.850	2° 26.250	04° 52.50	24.99	49.94	99.51
20.00	286.48	06.000	2° 30.000	05° 00.00	24.99	49.94	99.49
20.50	279.49	06.150	2° 33.750	05° 07.50	24.99	49.93	99.47
21.00	272.84	06.300	2° 37.500	05° 15.00	24.99	49.93	99.44
21.50	266.49	06.450	2° 41.250	05° 22.50	24.99	49.92	99.41
22.00	260.44	06.600	2° 45.000	05° 30.00	24.99	49.92	99.38
22.50	254.65	06.750	2° 48.750	05° 37.50	24.99	49.92	99.36
23.00	249.11	06.900	2° 52.500	05° 45.00	24.99	49.92	99.33
23.50	243.81	07.050	2° 56.250	05° 52.50	24.99	49.91	99.30
24.00	238.73	07.200	3° 00.000	06° 00.00	24.99	49.91	99.27
24.50	233.86	07.350	3° 03.750	06° 07.50	24.98	49.90	99.24
25.00	229.18	07.500	3° 07.500	06° 15.00	24.98	49.90	99.21
26.00	220.37	07.800	3° 15.000	06° 30.00	24.98	49.89	99.14
27.00	212.21	08.100	3° 22.500	06° 45.00	24.98	49.88	99.08
28.00	204.63	08.400	3° 30.000	07° 00.00	24.98	49.87	99.00
29.00	197.57	08.700	3° 37.500	07° 15.00	24.98	49.87	98.94

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 30′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
30.00	190.99	09.000	3° 45.000	07° 30.00	24.98	49.86	98.86
31.00	184.83	09.300	3° 52.500	07° 45.00	24.98	49.84	98.78
32.00	179.05	09.600	4° 00.000	08° 00.00	24.98	49.83	98.70
33.00	173.62	09.900	4° 07.500	08° 15.00	24.98	49.82	98.62
34.00	168.52	10.200	4° 15.000	08° 30.00	24.98	49.81	98.53
35.00	163.70	10.500	4° 22.500	08° 45.00	24.98	49.80	98.45
36.00	159.15	10.800	4° 30.000	09° 00.00	24.98	49.79	98.36
37.00	154.85	11.100	4° 37.500	09° 15.00	24.97	49.78	98.27
38.00	150.78	11.400	4° 45.000	09° 30.00	24.97	49.77	98.17
39.00	146.91	11.700	4° 52.500	09° 45.00	24.97	49.76	98.08
40.00	143.24	12.000	5° 00.000	10° 00.00	24.97	49.74	97.98
41.00	139.75	12.300	5° 07.500	10° 15.00	24.97	49.73	97.88
42.00	136.42	12.600	5° 15.000	10° 30.00	24.96	49.72	97.78
43.00	133.25	12.900	5° 22.500	10° 45.00	24.96	49.70	97.66
44.00	130.22	13.200	5° 30.000	11° 00.00	24.96	49.69	97.56
45.00	127.32	13.500	5° 37.500	11° 15.00	24.96	49.68	97.44
46.00	124.56	13.800	5° 45.000	11° 30.00	24.96	49.66	97.33
47.00	121.91	14.100	5° 52.500	11° 45.00	24.96	49.65	97.22
48.00	119.37	14.400	6° 00.000	12° 00.00	24.96	49.64	97.10
49.00	116.93	14.700	6° 07.500	12° 15.00	24.95	49.62	96.98
50.00	114.59	15.000	6° 15.000	12° 30.00	24.95	49.60	96.86
51.00	112.34	15.300	6° 22.500	12° 45.00	24.95	49.59	96.73
52.00	110.18	15.600	6° 30.000	13° 00.00	24.94	49.57	96.60
53.00	108.11	15.900	6° 37.500	13° 15.00	24.94	49.55	96.47
54.00	106.10	16.200	6° 45.000	13° 30.00	24.94	49.54	96.34
55.00	104.17	16.500	6° 52.500	13° 45.00	24.94	49.52	96.20
56.00	102.31	16.800	7° 00.000	14° 00.00	24.94	49.50	96.06

TABLE II

DEFLECTION UNIT TABLE

Giving deflection angles "i" from P.S. to any point on the spiral, and other functions for a = 1. Multiply values in table by the value of "a" in the particular problem to obtain the desired data.

The correction, "n", has been applied to values of "i" for a = 1. Since the correction varies as the cube of "S" and "S" varies with "a" the values of "i" and "I" obtained will be slightly in error for some values of "a" on long spirals.

The exact value of "n" in the formula i = ⅓ S — n can be obtained from the following table or may be calculated from the approximate formula n (in minutes) = 0.000052 S^3 (S in degrees).

S°	n'	S°	n'	S°	n'	S°	n'	S°	n'
1	0.000	11	0.069	21	0.479	31	1.547	41	3.599
2	0.000	12	0.089	22	0.551	32	1.703	42	3.871
3	0.001	13	0.113	23	0.630	33	1.868	43	4.157
4	0.003	14	0.142	24	0.716	34	2.044	44	4.457
5	0.006	15	0.174	25	0.810	35	2.231	45	4.771
6	0.011	16	0.212	26	0.911	36	2.430	46	5.100
7	0.018	17	0.254	27	1.021	37	2.639	47	5.443
8	0.026	18	0.302	28	1.139	38	2.861	48	5.802
9	0.038	19	0.355	29	1.266	39	3.094	49	6.177
10	0.052	20	0.414	30	1.402	40	3.340	50	6.568

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
0.01	0° 00.6′	0.003	0.001	0.002
.02	01.2′	0.012	0.004	0.008
.03	01.8′	0.027	0.009	0.018
.04	02.4′	0.048	0.016	0.032
.05	03.0′	0.075	0.025	0.050
.06	03.6′	0.108	0.036	0.072
.07	04.2′	0.147	0.049	0.098
.08	04.8′	0.192	0.064	0.128
.09	05.4′	0.243	0.081	0.162
.10	06.0′	0.300	0.100	0.200
.11	06.6′	0.363	0.121	0.242
.12	07.2′	0.432	0.144	0.288
.13	07.8′	0.507	0.169	0.338
.14	08.4′	0.588	0.196	0.392
.15	09.0′	0.675	0.225	0.450
.16	09.6′	0.768	0.256	0.512
.17	10.2′	0.867	0.289	0.578
.18	10.8′	0.972	0.324	0.648
.19	11.4′	1.083	0.361	0.722
.20	12.0′	1.200	0.400	0.800
.21	12.6′	1.323	0.441	0.882
.22	13.2′	1.452	0.484	0.968
.23	13.8′	1.587	0.529	1.058
.24	14.4′	1.728	0.576	1.152
.25	15.0′	1.875	0.625	1.250
.26	15.6′	2.028	0.676	1.352
.27	16.2′	2.187	0.729	1.458
.28	16.8′	2.352	0.784	1.568
.29	17.4′	2.523	0.841	1.682
.30	18.0′	2.700	0.900	1.800
.31	18.6′	2.883	0.961	1.922
.32	19.2′	3.072	1.024	2.048
.33	19.8′	3.267	1.089	2.178
.34	20.4′	3.468	1.156	2.312
.35	21.0′	3.675	1.225	2.450
.36	21.6′	3.888	1.296	2.592
.37	22.2′	4.107	1.369	2.738
.38	22.8′	4.332	1.444	2.888
.39	23.4′	4.563	1.521	3.042
.40	24.0′	4.800	1.600	3.200
.41	24.6′	5.043	1.681	3.362
.42	25.2′	5.292	1.764	3.528
.43	25.8′	5.547	1.849	3.698
.44	26.4′	5.808	1.936	3.872
.45	27.0′	6.075	2.025	4.050
.46	27.6′	6.348	2.116	4.232
.47	28.2′	6.627	2.209	4.418
.48	28.8′	6.912	2.304	4.608
.49	29.4′	7.203	2.401	4.802
0.50	0° 30.0′	7.500	2.500	5.000

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
0.50	0° 30.0′	7.500	2.500	5.000
.51	30.6′	7.803	2.601	5.202
.52	31.2′	8.112	2.704	5.408
.53	31.8′	8.427	2.809	5.618
.54	32.4′	8.748	2.916	5.832
.55	33.0′	9.075	3.025	6.050
.56	33.6′	9.408	3.136	6.272
.57	34.2′	9.747	3.249	6.498
.58	34.8′	10.092	3.364	6.728
.59	35.4′	10.443	3.481	6.962
.60	36.0′	10.800	3.600	7.200
.61	36.6′	11.163	3.721	7.442
.62	37.2′	11.532	3.844	7.688
.63	37.8′	11.907	3.969	7.938
.64	38.4′	12.288	4.096	8.192
.65	39.0′	12.675	4.225	8.450
.66	39.6′	13.068	4.356	8.712
.67	40.2′	13.467	4.489	8.978
.68	40.8′	13.872	4.624	9.248
.69	41.4′	14.283	4.761	9.522
.70	42.0′	14.700	4.900	9.800
.71	42.6′	15.123	5.041	10.082
.72	43.2′	15.552	5.184	10.368
.73	43.8′	15.987	5.329	10.658
.74	44.4′	16.428	5.476	10.952
.75	45.0′	16.875	5.625	11.250
.76	45.6′	17.328	5.776	11.552
.77	46.2′	17.787	5.929	11.858
.78	46.8′	18.252	6.084	12.168
.79	47.4′	18.723	6.241	12.482
.80	48.0′	19.200	6.400	12.800
.81	48.6′	19.683	6.561	13.122
.82	49.2′	20.172	6.724	13.448
.83	49.8′	20.667	6.889	13.778
.84	50.4′	21.168	7.056	14.112
.85	51.0′	21.675	7.225	14.450
.86	51.6′	22.188	7.396	14.792
.87	52.2′	22.707	7.569	15.138
.88	52.8′	23.232	7.744	15.488
.89	53.4′	23.763	7.921	15.842
.90	54.0′	24.300	8.100	16.200
.91	54.6′	24.843	8.281	16.562
.92	55.2′	25.392	8.464	16.928
.93	55.8′	25.947	8.649	17.298
.94	56.4′	26.508	8.836	17.672
.95	57.0′	27.075	9.025	18.050
.96	57.6′	27.648	9.216	18.432
.97	58.2′	28.227	9,409	18.818
.98	58.8′	28.812	9.604	19.208
0.99	0° 59.4′	29.403	9.801	19.602
1.00	1° 00.0′	30.000	10.000	20.000

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
1.00	1° 00.0′	30.000	10.000	20.000
1.01	1° 00.6′	30.603	10.201	20.402
1.02	1° 01.2′	31.212	10.404	20.808
1.03	1° 01.8′	31.827	10.609	21.218
1.04	1° 02.4′	32.448	10.816	21.632
1.05	1° 03.0′	33.075	11.025	22.050
1.06	1° 03.6′	33.708	11.236	22.472
1.07	1° 04.2′	34.347	11.449	22.898
1.08	1° 04.8′	34.992	11.664	23.328
1.09	1° 05.4′	35.643	11.881	23.762
1.10	1° 06.0′	36.300	12.100	24.200
1.11	1° 06.6′	36.963	12.321	24.642
1.12	1° 07.2′	37.632	12.544	25.088
1.13	1° 07.8′	38.307	12,769	25.538
1.14	1° 08.4′	38.988	12.996	25.992
1.15	1° 09.0′	39.675	13.225	26.450
1.16	1° 09.6′	40.368	13.456	26.912
1.17	1° 10.2′	41.067	13.689	27.378
1.18	1° 10.8′	41.772	13.924	27.848
1.19	1° 11.4′	42.483	14.161	28.322
1.20	1° 12.0′	43.200	14.400	28.800
1.21	1° 12.6′	43.923	14.641	29.282
1.22	1° 13.2′	44.652	14.884	29.768
1.23	1° 13.8′	45.387	15.129	30.258
1.24	1° 14.4′	46.128	15.376	30.752
1.25	1° 15.0′	46.875	15.625	31.250
1.26	1° 15.6′	47.628	15.876	31.752
1.27	1° 16.2′	48.387	16.129	32.258
1.28	1° 16.8′	49.152	16.384	32.768
1.29	1° 17.4′	49.923	16.641	33.282
1.30	1° 18.0′	50.700	16.900	33.800
1.31	1° 18.6′	51.483	17.161	34.322
1.32	1° 19.2′	52.272	17.424	34.848
1.33	1° 19.8′	53.067	17.689	35.378
1.34	1° 20.4′	53.868	17.956	35.912
1.35	1° 21.0′	54.675	18.225	36.450
1.36	1° 21.6′	55.488	18.496	36.992
1.37	1° 22.2′	56.307	18.769	37.538
1.38	1° 22.8′	57.132	19.044	38.088
1.39	1° 23.4′	57.963	19.321	38.642
1.40	1° 24.0′	58.800	19.600	39.200
1.41	1° 24.6′	59.643	19.881	39.762
1.42	1° 25.2′	60.492	20.164	40.328
1.43	1° 25.8′	61.347	20.449	40.898
1.44	1° 26.4′	62.208	20.736	41.472
1.45	1° 27.0′	63.075	21.025	42.050
1.46	1° 27.6′	63.948	21.316	42.632
1.47	1° 28.2′	64.827	21.609	43.218
1.48	1° 28.8′	65.712	21.904	43.808
1.49	1° 29.4′	66.603	22.201	44.402
1.50	1° 30.0′	67.500	22.500	45.000

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
1.50	1° 30.0′	67.500	22.500	45.000
1.51	1° 30.6′	68.403	22.801	45.602
1.52	1° 31.2′	69.312	23.104	46.208
1.53	1° 31.8′	70.227	23.409	46.818
1.54	1° 32.4′	71.148	23.716	47.432
1.55	1° 33.0′	72.075	24.025	48.050
1.56	1° 33.6′	73.008	24.336	48.672
1.57	1° 34.2′	73.947	24.649	49.298
1.58	1° 34.8′	74.892	24.964	49.928
1.59	1° 35.4′	75.843	25.281	50.562
1.60	1° 36.0′	76.800	25.600	51.200
1.61	1° 36.6′	77.763	25.921	51.842
1.62	1° 37.2′	78.732	26.244	52.488
1.63	1° 37.8′	79.707	26.569	53.138
1.64	1° 38.4′	80.688	26.896	53.792
1.65	1° 39.0′	81.675	27.225	54.450
1.66	1° 39.6′	82.668	27.556	55.112
1.67	1° 40.2′	83.667	27.889	55.778
1.68	1° 40.8′	84.672	28.224	56.448
1.69	1° 41.4′	85.683	28.561	57.122
1.70	1° 42.0′	86.700	28.900	57.800
1.71	1° 42.6′	87.723	29.241	58.482
1.72	1° 43.2′	88.752	29.584	59.168
1.73	1° 43.8′	89.787	29.929	59.858
1.74	1° 44.4′	90.828	30.276	60.552
1.75	1° 45.0′	91.875	30.625	61.250
1.76	1° 45.6′	92.928	30.976	61.952
1.77	1° 46.2′	93.987	31.329	62.658
1.78	1° 46.8′	95.052	31.684	63.368
1.79	1° 47.4′	96.123	32.041	64.082
1.80	1° 48.0′	97.200	32.400	64.800
1.81	1° 48.6′	98.283	32.761	65.522
1.82	1° 49.2′	99.372	33.124	66.248
1.83	1° 49.8′	100.467	33.489	66.978
1.84	1° 50.4′	101.568	33.856	67.712
1.85	1° 51.0′	102.675	34.225	68.450
1.86	1° 51.6′	103.788	34.596	69.192
1.87	1° 52.2′	104.907	34.969	69.938
1.88	1° 52.8′	106.032	35.344	70.688
1.89	1° 53.4′	107.163	35.721	71.442
1.90	1° 54.0′	108.300	36.100	72.200
1.91	1° 54.6′	109.443	36.481	72.962
1.92	1° 55.2′	110.592	36.864	73.728
1.93	1° 55.8′	111.747	37.249	74.498
1.94	1° 56.4′	112.908	37.636	75.272
1.95	1° 57.0′	114.075	38.025	76.050
1.96	1° 57.6′	115.248	38.416	76.832
1.97	1° 58.2′	116.427	38.809	77.618
1.98	1° 58.8′	117.612	39.204	78.408
1.99	1° 59.4′	118.803	39.601	79.202
2.00	2° 00.0′	120.000	40.000	80.000

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
2.00	2° 00.0′	120.000	40.000	80.000
2.01	2° 00.6′	121.203	40.401	80.802
2.02	2° 01.2′	122.412	40.804	81.608
2.03	2° 01.8′	123.627	41.209	82.418
2.04	2° 02.4′	124.848	41.616	83.232
2.05	2° 03.0′	126.075	42.025	84.050
2.06	2° 03.6′	127.308	42.436	84.872
2.07	2° 04.2′	128.547	42.848	85.699
2.08	2° 04.8′	129.792	43.263	86.529
2.09	2° 05.4′	131.043	43.680	87.363
2.10	2° 06.0′	132.300	44.099	88.201
2.11	2° 06.6′	133.563	44.520	89.043
2.12	2° 07.2′	134.832	44.943	89.889
2.13	2° 07.8′	136.107	45.368	90.739
2.14	2° 08.4′	137.388	45.795	91.593
2.15	2° 09.0′	138.675	46.224	92.451
2.16	2° 09.6′	139.968	46.655	93.313
2.17	2° 10.2′	141.267	47.088	94.179
2.18	2° 10.8′	142.572	47.523	95.049
2.19	2° 11.4′	143.883	47.960	95.923
2.20	2° 12.0′	145.200	48.399	96.801
2.21	2° 12.6′	146.523	48.840	97.683
2.22	2° 13.2′	147.852	49.283	98.569
2.23	2° 13.8′	149.187	49.728	99.459
2.24	2° 14.4′	150.528	50.175	100.353
2.25	2° 15.0′	151.875	50.624	101.251
2.26	2° 15.6′	153.228	51.075	102.153
2.27	2° 16.2′	154.587	51.528	103.059
2.28	2° 16.8′	155.952	51.983	103.969
2.29	2° 17.4′	157.323	52.440	104.883
2.30	2° 18.0′	158.700	52.899	105.801
2.31	2° 18.6′	160.083	53.360	106.723
2.32	2° 19.2′	161.472	53.823	107.649
2.33	2° 19.8′	162.867	54.288	108.579
2.34	2° 20.4′	164.268	54.755	109.513
2.35	2° 21.0′	165.675	55.224	110.451
2.36	2° 21.6′	167.088	55.695	111.393
2.37	2° 22.2′	168.507	56.168	112.339
2.38	2° 22.8′	169.932	56.643	113.289
2.39	2° 23.4′	171.363	57.120	114.243
2.40	2° 24.0′	172.800	57.599	115.201
2.41	2° 24.6′	174.243	58.080	116.163
2.42	2° 25.2′	175.692	58.563	117.129
2.43	2° 25.8′	177.147	59.048	118.099
2.44	2° 26.4′	178.608	59.535	119.073
2.45	2° 27.0′	180.075	60.024	120.051
2.46	2° 27.6′	181.548	60.515	121.033
2.47	2° 28.2′	183.027	61.008	122.019
2.48	2° 28.8′	184.512	61.503	123.009
2.49	2° 29.4′	186.003	61.999	124.004
2.50	2° 30.0′	187.500	62.498	125.002

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
2.50	2° 30.0′	187.500	62.498	125.002
2.51	2° 30.6′	189.003	62.999	126.004
2.52	2° 31.2′	190.512	63.502	127.010
2.53	2° 31.8′	192.027	64.007	128.020
2.54	2° 32.4′	193.548	64.514	129.034
2.55	2° 33.0′	195.075	65.023	130.052
2.56	2° 33.6′	196.608	65.534	131.074
2.57	2° 34.2′	198.147	66.047	132.100
2.58	2° 34.8′	199.692	66.562	133.130
2.59	2° 35.4′	201.243	67.079	134.164
2.60	2° 36.0′	202.800	67.598	135.202
2.61	2° 36.6′	204.363	68.119	136.244
2.62	2° 37.2′	205.932	68.642	137.290
2.63	2° 37.8′	207.507	69.167	138.340
2.64	2° 38.4′	209.088	69.694	139.394
2.65	2° 39.0′	210.675	70.223	140.452
2.66	2° 39.6′	212.268	70.754	141.514
2.67	2° 40.2′	213.867	71.287	142.580
2.68	2° 40.8′	215.472	71.822	143.650
2.69	2° 41.4′	217.083	72.359	144.724
2.70	2° 42.0′	218.700	72.897	145.803
2.71	2° 42.6′	220.323	73.438	146.885
2.72	2° 43.2′	221.952	73.981	147.971
2.73	2° 43.8′	223.587	74.526	149.061
2.74	2° 44.4′	225.228	75.073	150.155
2.75	2° 45.0′	226.875	75.622	151.253
2.76	2° 45.6′	228.528	76.173	152.355
2.77	2° 46.2′	230.187	76.726	153.461
2.78	2° 46.8′	231.852	77.281	154.571
2.79	2° 47.4′	233.523	77.838	155.685
2.80	2° 48.0′	235.200	78.397	156.803
2.81	2° 48.6′	236.883	78.958	157.925
2.82	2° 49.2′	238.572	79.521	159.051
2.83	2° 49.8′	240.267	80.086	160.181
2.84	2° 50.4′	241.968	80.653	161.315
2.85	2° 51.0′	243.675	81.222	162.453
2.86	2° 51.6′	245.388	81.792	163.596
2.87	2° 52.2′	247.107	82.365	164.742
2.88	2° 52.8′	248.832	82.940	165.892
2.89	2° 53.4′	250.563	83.517	167.046
2.90	2° 54.0′	252.300	84.096	168.204
2.91	2° 54.6′	254.043	84.677	169.366
2.92	2° 55.2′	255.792	85.260	170.532
2.93	2° 55.8′	257.547	85.845	171.702
2.94	2° 56.4′	259.308	86.432	172.876
2.95	2° 57.0′	261.075	87.021	174.054
2.96	2° 57.6′	262.848	87.612	175.236
2.97	2° 58.2′	264.627	88.205	176.422
2.98	2° 58.8′	266.412	88.799	177.613
2.99	2° 59.4′	268.203	89.396	178.807
3.00	3° 00.0′	270.000	89.995	180.005

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
3.00	3° 00.0′	270.000	89.995	180.005
3.01	3° 00.6′	271.803	90.596	181.207
3.02	3° 01.2′	273.612	91.199	182.413
3.03	3° 01.8′	275.427	91.804	183.623
3.04	3° 02.4′	277.248	92.411	184.837
3.05	3° 03.0′	279.075	93.020	106.055
3.06	3° 03.6′	280.908	93.631	187.277
3.07	3° 04.2′	282.747	94.244	188.503
3.08	3° 04.8′	284.592	94.859	189.733
3.09	3° 05.4′	286.443	95.475	190.968
3.10	3° 06.0′	288.300	96.094	192.206
3.11	3° 06.6′	290.163	96.715	193.448
3.12	3° 07.2′	292.032	97.338	194.694
3.13	3° 07.8′	293.907	97.963	195.944
3.14	3° 08.4′	295.788	98.590	197.198
3.15	3° 09.0′	297.675	99.219	198.456
3.16	3° 09.6′	299.568	99.850	199.718
3.17	3° 10.2′	301.467	100.482	200.985
3.18	3° 10.8′	303.372	101.117	202.255
3.19	3° 11.4′	305.283	101.754	203.529
3.20	3° 12.0′	307.200	102.393	204.807
3.21	3° 12.6′	309.123	103.034	206.089
3.22	3° 13.2′	311.052	103.677	207.375
3.23	3° 13.8′	312.987	104.322	208.665
3.24	3° 14.4′	314.928	104.969	209.959
3.25	3° 15.0′	316.875	105.617	211.258
3.26	3° 15.6′	318.828	106.268	212.560
3.27	3° 16.2′	320.787	106.921	213.866
3.28	3° 16.8′	322.752	107.576	215.176
3.29	3° 17.4′	324.723	108.233	216.490
3.30	3° 18.0′	326.700	108.892	217.808
3.31	3° 18.6′	328.683	109.553	219.130
3.32	3° 19.2′	330.672	110.215	220.457
3.33	3° 19.8′	332.667	110.880	221.787
3.34	3° 20.4′	334.668	111.547	223.121
3.35	3° 21.0′	336.675	112.216	224.459
3.36	3° 21.6′	338.688	112.887	225.801
3.37	3° 22.2′	340.707	113.560	227.147
3.38	3° 22.8′	342.732	114.234	228.498
3.39	3° 23.4′	344.763	114.911	229.852
3.40	3° 24.0′	346.800	115.590	231.210
3.41	3° 24.6′	348.843	116.271	232.572
3.42	3° 25.2′	350.892	116.954	233.938
3.43	3° 25.8′	352.947	117.639	235.308
3.44	3° 26.4′	355.008	118.325	236.683
3.45	3° 27.0′	357.075	119.014	238.061
3.46	3° 27.6′	359.148	119.705	239.443
3.47	3° 28.2′	361.227	120.398	240.829
3.48	3° 28.8′	363.312	121.093	242.219
3.49	3° 29.4′	365.403	121.789	243.614
3.50	3° 30.0′	367.500	122.488	245.012

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
3.50	3° 30.0′	367.500	122.488	245.012
3.51	3° 30.6′	369.603	123.189	246.414
3.52	3° 31.2′	371.712	123.892	247.820
3.53	3° 31.8′	373.827	124.597	249.230
3.54	3° 32.4′	375.948	125.303	250.645
3.55	3° 33.0′	378.075	126.012	252.063
3.56	3° 33.6′	380.208	126.723	253.485
3.57	3° 34.2′	382.347	127.436	254.911
3.58	3° 34.8′	384.492	128.150	256.342
3.59	3° 35.4′	386.643	128.867	257.776
3.60	3° 36.0′	388.800	129.586	259.214
3.61	3° 36.6′	390.963	130.307	260.656
3.62	3° 37.2′	393.132	131.029	262.103
3.63	3° 37.8′	395.307	131.754	263.553
3.64	3° 38.4′	397.488	132.481	265.007
3.65	3° 39.0′	399.675	133.210	266.465
3.66	3° 39.6′	401.868	133.941	267.927
3.67	3° 40.2′	404.067	134.673	269.394
3.68	3° 40.8′	406.272	135.408	270.864
3.69	3° 41.4′	408.483	136.145	272.338
3.70	3° 42.0′	410.700	136.883	273.817
3.71	3° 42.6′	412.923	137.624	275.299
3.72	3° 43.2′	415.152	138.367	276.785
3.73	3° 43.8′	417.387	139.112	278.275
3.74	3° 44.4′	419.628	139.858	279.770
3.75	3° 45.0′	421.875	140.607	281.268
3.76	3° 45.6′	424.128	141.358	282.770
3.77	3° 46.2′	426.387	142.110	284.277
3.78	3° 46.8′	428.652	142.865	285.787
3.79	3° 47.4′	430.923	143.622	287.301
3.80	3° 48.0′	433.200	144.381	288.819
3.81	3° 48.6′	435.483	145.141	290.342
3.82	3° 49.2′	437.772	145.904	291.868
3.83	3° 49.8′	440.067	146.669	293.398
3.84	3° 50.4′	442.368	147.435	294.933
3.85	3° 51.0′	444.675	148.204	296.471
3.86	3° 51.6′	446.988	148.975	298.013
3.87	3° 52.2′	449.307	149.747	299.560
3.88	3° 52.8′	451.632	150.522	301.110
3.89	3° 53.4′	453.963	151.299	302.664
3.90	3° 54.0′	456.300	152.077	304.223
3.91	3° 54.6′	458.643	152.858	305.785
3.92	3° 55.2′	460.992	153.641	307.351
3.93	3° 55.8′	463.347	154.425	308.922
3.94	3° 56.4′	465.708	155.212	310.496
3.95	3° 57.0′	468.075	156.000	312.075
3.96	3° 57.6′	470.448	156.791	313.657
3.97	3° 58.2′	472.827	157.584	315.243
3.98	3° 58.8′	475.212	158.378	316.834
3.99	3° 59.4′	477.603	159.175	318.428
4.00	4° 00.0′	480.000	159.974	320.026

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
4.00	4° 00.0′	480.000	159.974	320.026
4.01	4° 00.6′	482.403	160.774	321.629
4.02	4° 01.2′	484.812	161.577	323.235
4.03	4° 01.8′	487.227	162.381	324.846
4.04	4° 02.4′	489.648	163.188	326.460
4.05	4° 03.0′	492.075	163.997	328.078
4.06	4° 03.6′	494.508	164.807	329.701
4.07	4° 04.2′	496.947	165.620	331.327
4.08	4° 04.8′	499.392	166.434	332.958
4.09	4° 05.4′	501.843	167.251	334.592
4.10	4° 06.0′	504.300	168.069	336.231
4.11	4° 06.6′	506.763	168.890	337.873
4.12	4° 07.2′	509.232	169.712	339.520
4.13	4° 07.8′	511.707	170.537	341.170
4.14	4° 08.4′	514.188	171.364	342.824
4.15	4° 09.0′	516.675	172.192	344.483
4.16	4° 09.6′	519.168	173.023	346.145
4.17	4° 10.2′	521.667	173.855	347.812
4.18	4° 10.8′	524.172	174.690	349.482
4.19	4° 11.4′	526.683	175.526	351.157
4.20	4° 12.0′	529.200	176.365	352.835
4.21	4° 12.6′	531.723	177.205	354.518
4.22	4° 13.2′	534.252	178.048	356.204
4.23	4° 13.8′	536.787	178.892	357.895
4.24	4° 14.4′	539.328	179.739	359.589
4.25	4° 15.0′	541.875	180.587	361.288
4.26	4° 15.6′	544.428	181.437	362.991
4.27	4° 16.2′	546.987	182.290	364.697
4.28	4° 16.8′	549.552	183.144	366.408
4.29	4° 17.4′	552.123	184.001	368.122
4.30	4° 18.0′	554.700	184.859	369.841
4.31	4° 18.6′	557.283	185.720	371.563
4.32	4° 19.2′	559.872	186.582	373.290
4.33	4° 19.8′	562.467	187.446	375.021
4.34	4° 20.4′	565.068	188.313	376.755
4.35	4° 21.0′	567.675	189.181	378.494
4.36	4° 21.6′	570.288	190.052	380.236
4.37	4° 22.2′	572.907	190.924	381.983
4.38	4° 22.8′	575.532	191.798	383.734
4.39	4° 23.4′	578.163	192.675	385.488
4.40	4° 24.0′	580.800	193.553	387.247
4.41	4° 24.6′	583.443	194.433	389.010
4.42	4° 25.2′	586.092	195.315	390.777
4.43	4° 25.8′	588.747	196.200	392.547
4.44	4° 26.4′	591.408	197.087	394.321
4.45	4° 27.0′	594.075	197.975	396.100
4.46	4° 27.6′	596.748	198.865	397.883
4.47	4° 28.2′	599.427	199.758	399.669
4.48	4° 28.8′	602.112	200.652	401.460
4.49	4° 29.4′	604.803	201.548	403.255
4.50	4° 30.0′	607.500	202.446	405.054

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
4.50	4° 30.0′	607.500	202.446	405.054
4.51	4° 30.6′	610.203	203.347	406.856
4.52	4° 31.2′	612.912	204.249	408.663
4.53	4° 31.8′	615.627	205.153	410.474
4.54	4° 32.4′	618.348	206.060	412.288
4.55	4° 33.0′	621.075	206.968	414.107
4.56	4° 33.6′	623.808	207.878	415.930
4.57	4° 34.2′	626.547	208.790	417.757
4.58	4° 34.8′	629.292	209.704	419.588
4.59	4° 35.4′	632.043	210.621	421.422
4.60	4° 36.0′	634.800	211.539	423.261
4.61	4° 36.6′	637.563	212.459	425.104
4.62	4° 37.2′	640.332	213.381	426.951
4.63	4° 37.8′	643.107	214.305	428.802
4.64	4° 38.4′	645.888	215.232	430.656
4.65	4° 39.0′	648.675	216.160	432.515
4.66	4° 39.6′	651.468	217.090	434.378
4.67	4° 40.2′	654.267	218.022	436.245
4.68	4° 40.8′	657.072	218.956	438.116
4.69	4° 41.4′	659.883	219.892	439.991
4.70	4° 42.0′	662.700	220.830	441.870
4.71	4° 42.6′	665.523	221.771	443.752
4.72	4° 43.2′	668.352	222.713	445.639
4.73	4° 43.8′	671.187	223.657	447.530
4.74	4° 44.4′	674.028	224.603	449.425
4.75	4° 45.0′	676.875	225.551	451.324
4.76	4° 45.6′	679.728	226.501	453.227
4.77	4° 46.2′	682.587	227.453	455.134
4.78	4° 46.8′	685.452	228.407	457.045
4.79	4° 47.4′	688.323	229.363	458.960
4.80	4° 48.0′	691.200	230.321	460.879
4.81	4° 48.6′	694.083	231.281	462.802
4.82	4° 49.2′	696.972	232.243	464.729
4.83	4° 49.8′	699.867	233.207	466.660
4.84	4° 50.4′	702.768	234.173	468.595
4.85	4° 51.0′	705.675	235.141	470.534
4.86	4° 51.6′	708.588	236.111	472.477
4.87	4° 52.2′	711.507	237.083	474.424
4.88	4° 52.8′	714.432	238.057	476.375
4.89	4° 53.4′	717.363	239.033	478.330
4.90	4° 54.0′	720.300	240.011	480.289
4.91	4° 54.6′	723.243	240.991	482.252
4.92	4° 55.2′	726.192	241.972	484.220
4.93	4° 55.8′	729.147	242.956	486.191
4.94	4° 56.4′	732.108	243.942	488.166
4.95	4° 57.0′	735.075	244.930	490.145
4.96	4° 57.6′	738.048	245.920	492.128
4.97	4° 58.2′	741.027	246.912	494.115
4.98	4° 58.8′	744.012	247.906	496.106
4.99	4° 59.4′	747.003	248.901	498.102
5.00	5° 00.0′	750.000	249.899	500.101

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
5.00	5° 00.0′	750.000	249.899	500.101
5.01	5° 00.6′	753.003	250.899	502.104
5.02	5° 01.2′	756.012	251.901	504.111
5.03	5° 01.8′	759.027	252.904	506.123
5.04	5° 02.4′	762.048	253.910	508.138
5.05	5° 03.0′	765.075	254.918	510.157
5.06	5° 03.6′	768.108	255.928	512.180
5.07	5° 04.2′	771.147	256.939	514.208
5.08	5° 04.8′	774.192	257.953	516.239
5.09	5° 05.4′	777.243	258.969	518.274
5.10	5° 06.0′	780.300	259.986	520.314
5.11	5° 06.6′	783.363	261.006	522.357
5.12	5° 07.2′	786.432	262.028	524.404
5.13	5° 07.8′	789.507	263.051	526.456
5.14	5° 08.4′	792.588	264.077	528.511
5.15	5° 09.0′	795.675	265.105	530.570
5.16	5° 09.6′	798.768	266.134	532.634
5.17	5° 10.2′	801.867	267.166	534.701
5.18	5° 10.8′	804.972	268.199	536.773
5.19	5° 11.4′	808.083	269.235	538.848
5.20	5° 12.0′	811.200	270.272	540.928
5.21	5° 12.6′	814.323	271.312	543.011
5.22	5° 13.2′	817.452	272.353	545.099
5.23	5° 13.8′	820.587	273.397	547.190
5.24	5° 14.4′	823.728	274.442	549.286
5.25	5° 15.0′	826.875	275.490	551.385
5.26	5° 15.6′	830.028	276.539	553.489
5.27	5° 16.2′	833.187	277.591	555.596
5.28	5° 16.8′	836.352	278.644	557.708
5.29	5° 17.4′	839.523	279.700	559.823
5.30	5° 18.0′	842.700	280.757	561.943
5.31	5° 18.6′	845.883	281.816	564.067
5.32	5° 19.2′	849.072	282.878	566.194
5.33	5° 19.8′	852.267	283.941	568.326
5.34	5° 20.4′	855.468	285.006	570.462
5.35	5° 21.0′	858.675	286.074	572.601
5.36	5° 21.6′	861.888	287.143	574.745
5.37	5° 22.2′	865.107	288.214	576.893
5.38	5° 22.8′	868.332	289.287	579.045
5.39	5° 23.4′	871.563	290.363	581.200
5.40	5° 24.0′	874.800	291.440	583.360
5.41	5° 24.6′	878.043	292.519	585.524
5.42	5° 25.2′	881.292	293.600	587.692
5.43	5° 25.8′	884.547	294.684	589.863
5.44	5° 26.4′	887.808	295.769	592.039
5.45	5° 27.0′	891.075	296.856	594.219
5.46	5° 27.6′	894.348	297.945	596.403
5.47	5° 28.2′	897.627	299.036	598.591
5.48	5° 28.8′	900.912	300.129	600.783
5.49	5° 29.4′	904.203	301.224	602.979
5.50	5° 30.0′	907.500	302.321	605.179

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
5.50	5° 30.0′	907.500	302.321	605.179
5.51	5° 30.6′	910.803	303.420	607.383
5.52	5° 31.2′	914.112	304.521	609.591
5.53	5° 31.8′	917.427	305.624	611.803
5.54	5° 32.4′	920.748	306.729	614.019
5.55	5° 33.0′	924.075	307.836	616.239
5.56	5° 33.6′	927.408	308.945	618.463
5.57	5° 34.2′	930.747	310.056	620.691
5.58	5° 34.8′	934.092	311.169	622.923
5.59	5° 35.4′	937.443	312.284	625.159
5.60	5° 36.0′	940.800	313.401	627.399
5.61	5° 36.6′	944.163	314.520	629.643
5.62	5° 37.2′	947.532	315.641	631.891
5.63	5° 37.8′	950.907	316.763	634.144
5.64	5° 38.4′	954.288	317.888	636.400
5.65	5° 39.0′	957.675	319.015	638.660
5.66	5° 39.6′	961.068	320.144	640.924
5.67	5° 40.2′	964.467	321.274	643.193
5.68	5° 40.8′	967.872	322.407	645.465
5.69	5° 41.4′	971.283	323.542	647.741
5.70	5° 42.0′	974.700	324.679	650.021
5.71	5° 42.6′	978.123	325.817	652.306
5.72	5° 43.2′	981.552	326.958	654.594
5.73	5° 43.8′	984.987	328.100	656.887
5.74	5° 44.4′	988.428	329.245	659.183
5.75	5° 45.0′	991.875	330.392	661.483
5.76	5° 45.6′	995.328	331.540	663.788
5.77	5° 46.2′	998.787	332.691	666.096
5.78	5° 46.8′	1002.252	333.843	668.409
5.79	5° 47.4′	1005.723	334.998	670.725
5.80	5° 48.0′	1009.200	336.154	673.046
5.81	5° 48.6′	1012.683	337.313	675.370
5.82	5° 49.2′	1016.172	338.473	677.699
5.83	5° 49.8′	1019.667	339.635	680.032
5.84	5° 50.4′	1023.168	340.800	682.368
5.85	5° 51.0′	1026.675	341.966	684.709
5.86	5° 51.6′	1030.183	343.134	687.054
5.87	5° 52.2′	1033.707	344.305	689.402
5.88	5° 52.8′	1037.232	345.477	691.755
5.89	5° 53.4′	1040.763	346.651	694.112
5.90	5° 54.0′	1044.300	347.827	696.473
5.91	5° 54.6′	1047.843	349.006	698.837
5.92	5° 55.2′	1051.392	350.186	701.206
5.93	5° 55.8′	1054.947	351.368	703.579
5.94	5° 56.4′	1058.508	352.552	705.956
5.95	5° 57.0′	1062.075	353.738	708.337
5.96	5° 57.6′	1065.648	354.926	710.722
5.97	5° 58.2′	1069.227	356.116	713.111
5.98	5° 58.8′	1072.812	357.309	715.503
5.99	5° 59.4′	1076.403	358.503	717.900
6.00	6° 00.0′	1080.000	359.699	720.301

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
6.00	6° 00.0′	1080.000	359.699	720.301
6.01	6° 00.6′	1083.603	360.897	722.706
6.02	6° 01.2′	1087.212	362.096	725.116
6.03	6° 01.8′	1090.827	363.298	727.529
6.04	6° 02.4′	1094.448	364.502	729.946
6.05	6° 03.0′	1098.075	365.708	732.367
6.06	6° 03.6′	1101.708	366.916	734.792
6.07	6° 04.2′	1105.347	368.126	737.221
6.08	6° 04.8′	1108.992	369.338	739.654
6.09	6° 05.4′	1112.643	370.551	742.092
6.10	6° 06.0′	1116.300	371.767	744.533
6.11	6° 06.6′	1119.963	372.985	746.978
6.12	6° 07.2′	1123.632	374.204	749.428
6.13	6° 07.8′	1127.307	375.426	751.881
6.14	6° 08.4′	1130.988	376.650	754.338
6.15	6° 09.0′	1134.675	377.875	756.800
6.16	6° 09.6′	1138.368	379.103	759.265
6.17	6° 10.2′	1142.067	380.332	761.735
6.18	6° 10.8′	1145.772	381.564	764.208
6.19	6° 11.4′	1149.483	382.797	766.686
6.20	6° 12.0′	1153.200	384.033	769.167
6.21	6° 12.6′	1156.923	385.270	771.653
6.22	6° 13.2′	1160.652	386.510	774.142
6.23	6° 13.8′	1164.387	387.751	776.636
6.24	6° 14.4′	1168.128	388.994	779.134
6.25	6° 15.0′	1171.875	390.240	781.635
6.26	6° 15.6′	1175.628	391.487	784.141
6.27	6° 16.2′	1179.387	392.736	786.651
6.28	6° 16.8′	1183.152	393.987	789.165
6.29	6° 17.4′	1186.923	395.241	791.682
6.30	6° 18.0′	1190.700	396.496	794.204
6.31	6° 18.6′	1194.483	397.753	796.730
6.32	6° 19.2′	1198.272	399.012	799.260
6.33	6° 19.8′	1202.067	400.273	801.794
6.34	6° 20.4′	1205.868	401.536	804.332
6.35	6° 21.0′	1209.675	402.801	806.874
6.36	6° 21.6′	1213.488	404.068	809.420
6.37	6° 22.2′	1217.307	405.337	811.970
6.38	6° 22.8′	1221.132	406.608	814.524
6.39	6° 23.4′	1224.963	407.881	817.082
6.40	6° 24.0′	1228.800	409.156	819.644
6.41	6° 24.6′	1232.643	410.432	822.211
6.42	6° 25.2′	1236.492	411.711	824.781
6.43	6° 25.8′	1240.347	412.992	827.355
6.44	6° 26.4′	1244.208	414.275	829.933
6.45	6° 27.0′	1248.075	415.559	832.516
6.46	6° 27.6′	1251.948	416.846	835.102
6.47	6° 28.2′	1255.827	418.135	837.692
6.48	6° 28.8′	1259.712	419.425	840.287
6.49	6° 29.4′	1263.603	420.718	842.885
6.50	6° 30.0′	1267.500	422.012	845.488

UNIT TABLE a = 1.0

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
6.50	6° 30.0′	1267.500	422.012	845.488
6.51	6° 30.6′	1271.403	423.309	848.094
6.52	6° 31.2′	1275.312	424.607	850.705
6.53	6° 31.8′	1279.227	425.908	853.319
6.54	6° 32.4′	1283.148	427.210	855.938
6.55	6° 33.0′	1287.075	428.514	858.561
6.56	6° 33.6′	1291.008	429.821	861.187
6.57	6° 34.2′	1294.947	431.129	863.818
6.58	6° 34.8′	1298.892	432.439	866.453
6.59	6° 35.4′	1302.843	433.751	869.092
6.60	6° 36.0′	1306.800	435.065	871.735
6.61	6° 36.6′	1310.763	436.381	874.382
6.62	6° 37.2′	1314.732	437.699	877.033
6.63	6° 37.8′	1318.707	439.019	879.688
6.64	6° 38.4′	1322.688	440.342	882.346
6.65	6° 39.0′	1326.675	441.665	885.010
6.66	6° 39.6′	1330.668	442.991	887.677
6.67	6° 40.2′	1334.667	444.319	890.348
6.68	6° 40.8′	1338.672	445.649	893.023
6.69	6° 41.4′	1342.683	446.981	895.702
6.70	6° 42.0′	1346.700	448.315	898.385
6.71	6° 42.6′	1350.723	449.650	901.073
6.72	6° 43.2′	1354.752	450.988	903.764
6.73	6° 43.8′	1358.787	452.328	906.459
6.74	6° 44.4′	1362.828	453.669	909.159
6.75	6° 45.0′	1366.875	455.013	911.862
6.76	6° 45.6′	1370.928	456.358	914.570
6.77	6° 46.2′	1374.987	457.706	917.281
6.78	6° 46.8′	1379.052	459.055	919.997
6.79	6° 47.4′	1383.123	460.407	922.716
6.80	6° 48.0′	1387.200	461.760	925.440
6.81	6° 48.6′	1391.283	463.115	928.168
6.82	6° 49.2′	1395.372	464.473	930.899
6.83	6° 49.8′	1399.467	465.832	933.635
6.84	6° 50.4′	1403.568	467.193	936.375
6.85	6° 51.0′	1407.675	468.556	939.119
6.86	6° 51.6′	1411.788	469.921	941.867
6.87	6° 52.2′	1415.907	471.288	944.619
6.88	6° 52.8′	1420.032	472.657	947.375
6.89	6° 53.4′	1424.163	474.028	950.135
6.90	6° 54.0′	1428.300	475.401	952.899
6.91	6° 54.6′	1432.443	476.776	955.667
6.92	6° 55.2′	1436.592	478.153	958.439
6.93	6° 55.8′	1440.747	479.532	961.215
6.94	6° 56.4′	1444.908	480.913	963.995
6.95	6° 57.0′	1449.075	482.295	966.780
6.96	6° 57.6′	1453.248	483.680	969.568
6.97	6° 58.2′	1457.427	485.067	972.360
6.98	6° 58.8′	1461.612	486.455	975.157
6.99	6° 59.4′	1465.803	487.846	977.957
7.00	7° 00.0′	1470.000	489.238	980.762

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
7.00	7° 00.0′	1470.000	489.238	980.762
7.01	7° 00.6′	1474.203	490.633	983.570
7.02	7° 01.2′	1478.412	492.029	986.383
7.03	7° 01.8′	1482.627	493.427	989.200
7.04	7° 02.4′	1486.848	494.828	992.020
7.05	7° 03.0′	1491.075	496.230	994.845
7.06	7° 03.6′	1495.308	497.634	997.674
7.07	7° 04.2′	1499.547	499.040	1000.507
7.08	7° 04.8′	1503.792	500.448	1003.344
7.09	7° 05.4′	1508.043	501.858	1006.185
7.10	7° 06.0′	1512.300	503.270	1009.030
7.11	7° 06.6′	1516.563	504.684	1011.879
7.12	7° 07.2′	1520.832	506.100	1014.732
7.13	7° 07.8′	1525.107	507.518	1017.589
7.14	7° 08.4′	1529.388	508.938	1020.450
7.15	7° 09.0′	1533.675	510.360	1023.315
7.16	7° 09.6′	1537.968	511.783	1026.185
7.17	7° 10.2′	1542.267	513.209	1029.058
7.18	7° 10.8′	1546.572	514.636	1031.936
7.19	7° 11.4′	1550.883	516.066	1034.817
7.20	7° 12.0′	1555.200	517.497	1037.703
7.21	7° 12.6′	1559.523	518.931	1040.592
7.22	7° 13.2′	1563.852	520.366	1043.486
7.23	7° 13.8′	1568.187	521.804	1046.383
7.24	7° 14.4′	1572.528	523.243	1049.285
7.25	7° 15.0′	1576.875	524.684	1052.191
7.26	7° 15.6′	1581.228	526.127	1055.101
7.27	7° 16.2′	1585.587	527.572	1058.015
7.28	7° 16.8′	1589.952	529.019	1060.933
7.29	7° 17.4′	1594.323	530.468	1063.855
7.30	7° 18.0′	1598.700	531.919	1066.781
7.31	7° 18.6′	1603.083	533.372	1069.711
7.32	7° 19.2′	1607.472	534.827	1072.645
7.33	7° 19.8′	1611.867	536.284	1075.583
7.34	7° 20.4′	1616.268	537.742	1078.526
7.35	7° 21.0′	1620.675	539.203	1081.472
7.36	7° 21.6′	1625.088	540.666	1084.422
7.37	7° 22.2′	1629.507	542.130	1087.377
7.38	7° 22.8′	1633.932	543.597	1090.335
7.39	7° 23.4′	1638.363	545.065	1093.298
7.40	7° 24.0′	1642.800	546.536	1096.264
7.41	7° 24.6′	1647.243	548.008	1099.235
7.42	7° 25.2′	1651.692	549.482	1102.210
7.43	7° 25.8′	1656.147	550.958	1105.189
7.44	7° 26.4′	1660.608	552.436	1108.172
7.45	7° 27.0′	1665.075	553.916	1111.159
7.46	7° 27.6′	1669.548	555.398	1114.150
7.47	7° 28.2′	1674.027	556.882	1117.145
7.48	7° 28.8′	1678.512	558.368	1120.144
7.49	7° 29.4′	1683.003	559.856	1123.147
7.50	7° 30.0′	1687.500	561.346	1126.154

UNIT TABLE a = 1.0

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
7.50	7° 30.0′	1687.500	561.346	1126.154
7.51	7° 30.6′	1692.003	562.838	1129.165
7.52	7° 31.2′	1696.512	564.331	1132.181
7.53	7° 31.8′	1701.027	565.827	1135.200
7.54	7° 32.4′	1705.548	567.324	1138.224
7.55	7° 33.0′	1710.075	568.824	1141.251
7.56	7° 33.6′	1714.608	570.325	1144.283
7.57	7° 34.2′	1719.147	571.828	1147.319
7.58	7° 34.8′	1723.692	573.334	1150.358
7.59	7° 35.4′	1728.243	574.841	1153.402
7.60	7° 36.0′	1732.800	576.350	1156.450
7.61	7° 36.6′	1737.363	577.861	1159.502
7.62	7° 37.2′	1741.932	579.374	1162.558
7.63	7° 37.8′	1746.507	580.889	1165.618
7.64	7° 38.4′	1751.088	582.406	1168.682
7.65	7° 39.0′	1755.675	583.925	1171.750
7.66	7° 39.6′	1760.268	585.445	1174.823
7.67	7° 40.2′	1764.867	586.968	1177.899
7.68	7° 40.8′	1769.472	588.493	1180.979
7.69	7° 41.4′	1774.083	590.019	1184.064
7.70	7° 42.0′	1778.700	591.548	1187.152
7.71	7° 42.6′	1783.323	593.078	1190.245
7.72	7° 43.2′	1787.952	594.610	1193.342
7.73	7° 43.8′	1792.587	596.145	1196.442
7.74	7° 44.4′	1797.228	597.681	1199.547
7.75	7° 45.0′	1801.875	599.219	1202.656
7.76	7° 45.6′	1806.528	600.759	1205.769
7.77	7° 46.2′	1811.187	602.301	1208.886
7.78	7° 46.8′	1815.852	603.845	1212.007
7.79	7° 47.4′	1820.523	605.391	1215.132
7.80	7° 48.0′	1825.200	606.938	1218.262
7.81	7° 48.6′	1829.883	608.488	1221.395
7.82	7° 49.2′	1834.572	610.040	1224.532
7.83	7° 49.8′	1839.267	611.593	1227.674
7.84	7° 50.4′	1843.968	613.148	1230.820
7.85	7° 51.0′	1848.675	614.706	1233.969
7.86	7° 51.6′	1853.388	616.265	1237.123
7.87	7° 52.2′	1858.107	617.826	1240.281
7.88	7° 52.8′	1862.832	619.389	1243.443
7.89	7° 53.4′	1867.563	620.955	1246.608
7.90	7° 54.0′	1872.300	622.521	1249.779
7.91	7° 54.6′	1877.043	624.090	1252.953
7.92	7° 55.2′	1881.792	625.661	1256.131
7.93	7° 55.8′	1886.547	627.234	1259.313
7.94	7° 56.4′	1891.308	628.809	1262.499
7.95	7° 57.0′	1896.075	630.385	1265.690
7.96	7° 57.6′	1900.848	631.964	1268.884
7.97	7° 58.2′	1905.627	633.544	1272.083
7.98	7° 58.8′	1910.412	635.127	1275.285
7.99	7° 59.4′	1915.203	636.711	1278.492
8.00	8° 00.0′	1920.000	638.297	1281.703

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
8.00	8° 00.0′	1920.000	638.297	1281.703
8.01	8° 00.6′	1924.803	639.885	1284.918
8.02	8° 01.2′	1929.612	641.475	1288.137
8.03	8° 01.8′	1934.427	643.067	1291.360
8.04	8° 02.4′	1939.248	644.661	1294.587
8.05	8° 03.0′	1944.075	646.257	1297.818
8.06	8° 03.6′	1948.908	647.855	1301.053
8.07	8° 04.2′	1953.747	649.454	1304.293
8.08	8° 04.8′	1958.592	651.056	1307.536
8.09	8° 05.4′	1963.443	652.659	1310.784
8.10	8° 06.0′	1968.300	654.265	1314.035
8.11	8° 06.6′	1973.163	655.872	1317.291
8.12	8° 07.2′	1978.032	657.481	1320.551
8.13	8° 07.8′	1982.907	659.092	1323.815
8.14	8° 08.4′	1987.788	660.705	1327.083
8.15	8° 09.0′	1992.675	662.320	1330.355
8.16	8° 09.6′	1997.568	663.937	1333.631
8.17	8° 10.2′	2002.467	665.556	1336.911
8.18	8° 10.8′	2007.372	667.177	1340.195
8.19	8° 11.4′	2012.283	668.799	1343.484
8.20	8° 12.0′	2017.200	670.424	1346.776
8.21	8° 12.6′	2022.123	672.050	1350.073
8.22	8° 13.2′	2027.052	673.678	1353.374
8.23	8° 13.8′	2031.987	675.309	1356.678
8.24	8° 14.4′	2036.928	676.941	1359.987
8.25	8° 15.0′	2041.875	678.575	1363.300
8.26	8° 15.6′	2046.828	680.211	1366.617
8.27	8° 16.2′	2051.787	681.849	1369.938
8.28	8° 16.8′	2056.752	683.488	1373.264
8.29	8° 17.4′	2061.723	685.130	1376.593
8.30	8° 18.0′	2066.700	686.774	1379.926
8.31	8° 18.6′	2071.683	688.419	1383.264
8.32	8° 19.2′	2076.672	690.067	1386.605
8.33	8° 19.8′	2081.667	691.716	1389.951
8.34	8° 20.4′	2086.668	693.367	1393.301
8.35	8° 21.0′	2091.675	695.020	1396.655
8.36	8° 21.6′	2096.688	696.675	1400.013
8.37	8° 22.2′	2101.707	698.332	1403.375
8.38	8° 22.8′	2106.732	699.991	1406.741
8.39	8° 23.4′	2111.763	701.652	1410.111
8.40	8° 24.0′	2116.800	703.314	1413.486
8.41	8° 24.6′	2121.843	704.979	1416.864
8.42	8° 25.2′	2126.892	706.645	1420.247
8.43	8° 25.8′	2131.947	708.314	1423.633
8.44	8° 26.4′	2137.008	709.984	1427.024
8.45	8° 27.0′	2142.075	711.656	1430.419
8.46	8° 27.6′	2147.148	713.330	1433.818
8.47	8° 28.2′	2152.227	715.006	1437.221
8.48	8° 28.8′	2157.312	716.684	1440.628
8.49	8° 29.4′	2162.403	718.363	1444.040
8.50	8° 30.0′	2167.500	720.045	1447.455

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
8.50	8° 30.0′	2167.500	720.045	1447.455
8.51	8° 30.6′	2172.603	721.728	1450.875
8.52	8° 31.2′	2177.712	723.414	1454.298
8.53	8° 31.8′	2182.827	725.101	1457.726
8.54	8° 32.4′	2187.948	726.790	1461.158
8.55	8° 33.0′	2193.075	728.482	1464.593
8.56	8° 33.6′	2198.208	730.174	1468.034
8.57	8° 34.2′	2203.347	731.869	1471.478
8.58	8° 34.8′	2208.492	733.566	1474.926
8.59	8° 35.4′	2213.643	735.265	1478.378
8.60	8° 36.0′	2218.800	736.965	1481.835
8.61	8° 36.6′	2223.963	738.668	1485.295
8.62	8° 37.2′	2229.132	740.372	1488.760
8.63	8° 37.8′	2234.307	742.078	1492.229
8.64	8° 38.4′	2239.488	743.786	1495.702
8.65	8° 39.0′	2244.675	745.496	1499.179
8.66	8° 39.6′	2249.868	747.208	1502.660
8.67	8° 40.2′	2255.067	748.922	1506.145
8.68	8° 40.8′	2260.272	750.638	1509.634
8.69	8° 41.4′	2265.483	752.355	1513.128
8.70	8° 42.0′	2270.700	754.075	1516.625
8.71	8° 42.6′	2275.923	755.796	1520.127
8.72	8° 43.2′	2281.152	757.519	1523.633
8.73	8° 43.8′	2286.387	759.244	1527.143
8.74	8° 44.4′	2291.628	760.971	1530.657
8.75	8° 45.0′	2296.875	762.700	1534.175
8.76	8° 45.6′	2302.128	764.431	1537.697
8.77	8° 46.2′	2307.387	766.163	1541.224
8.78	8° 46.8′	2312.652	767.898	1544.754
8.79	8° 47.4′	2317.923	769.634	1548.289
8.80	8° 48.0′	2323.200	771.373	1551.827
8.81	8° 48.6′	2328.483	773.113	1555.370
8.82	8° 49.2′	2333.772	774.855	1558.917
8.83	8° 49.8′	2339.067	776.599	1562.468
8.84	8° 50.4′	2344.368	778.344	1566.024
8.85	8° 51.0′	2349.675	780.092	1569.583
8.86	8° 51.6′	2354.988	781.842	1573.146
8.87	8° 52.2′	2360.307	783.593	1576.714
8.88	8° 52.8′	2365.632	785.346	1580.286
8.89	8° 53.4′	2370.963	787.101	1583.862
8.90	8° 54.0′	2376.300	788.858	1587.442
8.91	8° 54.6′	2381.643	790.617	1591.026
8.92	8° 55.2′	2386.992	792.378	1594.614
8.93	8° 55.8′	2392.347	794.141	1598.206
8.94	8° 56.4′	2397.708	795.905	1601.803
8.95	8° 57.0′	2403.075	797.672	1605.403
8.96	8° 57.6′	2408.448	799.440	1609.008
8.97	8° 58.2′	2413.827	801.210	1612.617
8.98	8° 58.8′	2419.212	802.982	1616.230
8.99	8° 59.4′	2424.603	804.756	1619.847
9.00	9° 00.0′	2430.000	806.532	1623.468

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
9.00	9° 00.0′	2430.000	806.532	1623.468
9.01	9° 00.6′	2435.403	808.310	1627.093
9.02	9° 01.2′	2440.812	810.089	1630.723
9.03	9° 01.8′	2446.227	811.870	1634.357
9.04	9° 02.4′	2451.648	813.654	1637.994
9.05	9° 03.0′	2457.075	815.439	1641.636
9.06	9° 03.6′	2462.508	817.226	1645.282
9.07	9° 04.2′	2467.947	819.015	1648.932
9.08	9° 04.8′	2473.392	820.806	1652.586
9.09	9° 05.4′	2478.843	822.598	1656.245
9.10	9° 06.0′	2484.300	824.392	1659.908
9.11	9° 06.6′	2489.763	826.188	1663.575
9.12	9° 07.2′	2495.232	827.986	1667.246
9.13	9° 07.8′	2500.707	829.786	1670.921
9.14	9° 08.4′	2506.188	831.588	1674.600
9.15	9° 09.0′	2511.675	833.392	1678.283
9.16	9° 09.6′	2517.168	835.198	1681.970
9.17	9° 10.2′	2522.667	837.005	1685.662
9.18	9° 10.8′	2528.172	838.814	1689.358
9.19	9° 11.4′	2533.683	840.626	1693.057
9.20	9° 12.0′	2539.200	842.439	1696.761
9.21	9° 12.6′	2544.723	844.253	1700.470
9.22	9° 13.2′	2550.252	846.070	1704.182
9.23	9° 13.8′	2555.787	847.889	1707.898
9.24	9° 14.4′	2561.328	849.709	1711.619
9.25	9° 15.0′	2566.875	851.531	1715.344
9.26	9° 15.6′	2572.428	853.356	1719.072
9.27	9° 16.2′	2577.987	855.182	1722.805
9.28	9° 16.8′	2583.552	857.009	1726.543
9.29	9° 17.4′	2589.123	858.839	1730.284
9.30	9° 18.0′	2594.700	860.671	1734.029
9.31	9° 18.6′	2600.283	862.504	1737.779
9.32	9° 19.2′	2605.872	864.339	1741.533
9.33	9° 19.8′	2611.467	866.176	1745.291
9.34	9° 20.4′	2617.068	868.015	1749.053
9.35	9° 21.0′	2622.675	869.856	1752.819
9.36	9° 21.6′	2628.288	871.699	1756.589
9.37	9° 22.2′	2633.907	873.543	1760.364
9.38	9° 22.8′	2639.532	875.389	1764.143
9.39	9° 23.4′	2645.163	877.237	1767.926
9.40	9° 24.0′	2650.800	879.088	1771.712
9.41	9° 24.6′	2656.443	880.939	1775.504
9.42	9° 25.2′	2662.092	882.793	1779.299
9.43	9° 25.8′	2667.747	884.649	1783.098
9.44	9° 26.4′	2673.408	886.506	1786.902
9.45	9° 27.0′	2679.075	888.365	1790.710
9.46	9° 27.6′	2684.748	890.226	1794.522
9.47	9° 28.2′	2690.427	892.089	1798.338
9.48	9° 28.8′	2696.112	893.954	1802.158
9.49	9° 29.4′	2701.803	895.820	1805.983
9.50	9° 30.0′	2707.500	897.689	1809.811

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
9.50	9° 30.0′	2707.500	897.689	1809.811
9.51	9° 30.6′	2713.203	899.559	1813.644
9.52	9° 31.2′	2718.912	901.431	1817.481
9.53	9° 31.8′	2724.627	903.305	1821.322
9.54	9° 32.4′	2730.348	905.181	1825.167
9.55	9° 33.0′	2736.075	907.058	1829.017
9.56	9° 33.6′	2741.808	908.937	1832.871
9.57	9° 34.2′	2747.547	910.819	1836.728
9.58	9° 34.8′	2753.292	912.702	1840.590
9.59	9° 35.4′	2759.043	914.587	1844.456
9.60	9° 36.0′	2764.800	916.473	1848.327
9.61	9° 36.6′	2770.563	918.362	1852.201
9.62	9° 37.2′	2776.332	920.252	1856.080
9.63	9° 37.8′	2782.107	922.144	1859.963
9.64	9° 38.4′	2787.888	924.038	1863.850
9.65	9° 39.0′	2793.675	925.934	1867.741
9.66	9° 39.6′	2799.468	927.832	1871.636
9.67	9° 40.2′	2805.267	929.731	1875.536
9.68	9° 40.8′	2811.072	931.633	1879.439
9.69	9° 41.4′	2816.883	933.536	1883.347
9.70	9° 42.0′	2822.700	935.441	1887.259
9.71	9° 42.6′	2828.523	937.348	1891.175
9.72	9° 43.2′	2834.352	939.256	1895.096
9.73	9° 43.8′	2840.187	941.167	1899.020
9.74	9° 44.4′	2846.028	943.079	1902.949
9.75	9° 45.0′	2851.875	944.993	1906.882
9.76	9° 45.6′	2857.728	946.909	1910.819
9.77	9° 46.2′	2863.587	948.826	1914.761
9.78	9° 46.8′	2869.452	850.746	1918.706
9.79	9° 47.4′	2875.323	952.667	1922.656
9.80	9° 48.0′	2881.200	954.590	1926.610
9.81	9° 48.6′	2887.083	956.515	1930.568
9.82	9° 49.2′	2892.972	958.442	1934.530
9.83	9° 49.8′	2898.867	960.370	1938.497
9.84	9° 50.4′	2904.768	962.301	1942.467
9.85	9° 51.0′	2910.675	964.233	1946.442
9.86	9° 51.6′	2916.588	966.167	1950.421
9.87	9° 52.2′	2922.507	968.103	1954.404
9.88	9° 52.8′	2928.432	970.040	1958.392
9.89	9° 53.4′	2934.363	971.980	1962.383
9.90	9° 54.0′	2940.300	973.921	1966.379
9.91	9° 54.6′	2946.243	975.864	1970.379
9.92	9° 55.2′	2952.192	977.809	1974.383
9.93	9° 55.8′	2958.147	979.755	1978.392
9.94	9° 56.4′	2964.108	981.704	1982.404
9.95	9° 57.0′	2970.075	983.654	1986.421
9.96	9° 57.6′	2976.048	985.606	1990.442
9.97	9° 58.2′	2982.027	987.560	1994.467
9.98	9° 58.8′	2988.012	989.515	1998.497
9.99	9° 59.4′	2994.003	991.473	2002.530
10.00	10° 00.0′	3000.000	993.432	2006.568

TABLE III

Deflection from intermediate chord points on spirals to other chord points at 10′ intervals.

Giving deflections in minutes, for

$$\text{“a”} = \left(\frac{D}{L}\right) = 1,$$

from intermediate chord points to any other chord point at 10 foot intervals. Multiply tabular values by the actual value of “a” to obtain true values for the particular problem.

Interpolations may be made for any distance falling between points given in table.

Example: To obtain deflections for any series of points when transit is set at a point say 190 feet from the P. S.

In the table under the heading 190 follow down vertically to space marked 00. The figures on the horizontal line forward or back give deflection angles in minutes to the several points indicated at the top of the several columns.

Rule: Always work on the horizontal lines. Deflections are given either forward to the right or backward to the left from any point shown in the diagonal squares to the other points listed.

		10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
	P. S.	00.1	00.4	00.9	01.6	02.5	03.6	04.9	06.4	08.1	10.0	12.1	14.4	16.9	19.6	22.5	25.6	28.9	32.4	36.1	40.0
10	00.2	00	00.4	01.0	01.8	02.8	04.0	05.4	07.0	08.8	10.8	13.0	15.4	18.0	20.8	23.8	27.0	30.4	34.0	37.8	41.8
20	00.8	00.5	00	00.7	01.6	02.7	04.0	05.5	07.2	09.1	11.2	13.5	16.0	18.7	21.6	24.7	28.0	31.5	35.2	39.1	43.2
30	01.8	01.4	00.8	00	01.0	02.2	03.6	05.2	07.0	09.0	11.2	13.6	16.2	19.0	22.0	25.2	28.6	32.2	36.0	40.0	44.2
40	03.2	02.7	02.0	01.1	00	01.3	02.8	04.5	06.4	08.5	10.8	13.3	16.0	18.9	22.0	25.3	28.8	32.5	36.4	40.5	44.8
50	05.0	04.4	03.6	02.6	01.4	00	01.6	03.4	05.4	07.6	10.0	12.6	15.4	18.4	21.6	25.0	28.6	32.4	36.4	40.6	45.0
60	07.2	06.5	05.6	04.5	03.2	01.7	00	01.9	04.0	06.3	08.8	11.5	14.4	17.5	20.8	24.3	28.0	31.9	36.0	40.3	44.8
70	09.8	09.0	08.0	06.8	05.4	03.8	02.0	00	02.2	04.6	07.2	10.0	13.0	16.2	19.6	23.2	27.0	31.0	35.2	39.6	44.2
80	12.8	11.9	10.8	09.5	08.0	06.3	04.4	02.3	00	02.5	05.2	08.1	11.2	14.5	18.0	21.7	25.6	29.7	34.0	38.5	43.2
90	16.2	15.2	14.0	12.6	11.0	09.2	07.2	05.0	02.6	00	02.8	05.8	09.0	12.4	16.0	19.8	23.8	28.0	32.4	37.0	41.8
100	20.0	18.9	17.6	16.1	14.4	12.5	10.4	08.1	05.6	02.9	00	03.1	06.4	09.9	13.6	17.5	21.6	25.9	30.4	35.1	40.0
110	24.2	23.0	21.6	20.0	18.2	16.2	14.0	11.6	09.0	06.2	03.2	00	03.4	07.0	10.8	14.8	19.0	23.4	28.0	32.8	37.8
120	28.8	27.5	26.0	24.3	22.4	20.3	18.0	15.5	12.8	09.9	06.8	03.5	00	03.7	07.6	11.7	16.0	20.5	25.2	30.1	35.2
130	33.8	32.4	30.8	29.0	27.0	24.8	22.4	19.8	17.0	14.0	10.8	07.4	03.8	00	04.0	08.2	12.6	17.2	22.0	27.0	32.2
140	39.2	37.7	36.0	34.1	32.0	29.7	27.2	24.5	21.6	18.5	15.2	11.7	08.0	04.1	00	04.3	08.8	13.5	18.4	23.5	28.8
150	45.0	43.4	41.6	39.6	37.4	35.0	32.4	29.6	26.6	23.4	20.0	16.4	12.6	08.6	04.4	00	04.6	09.4	14.4	19.6	25.0
160	51.2	49.5	47.6	45.5	43.2	40.7	38.0	35.1	32.0	28.7	25.2	21.5	17.6	13.5	09.2	04.7	00	04.9	10.0	15.3	20.8
170	57.8	56.0	54.0	51.8	49.4	46.8	44.0	41.0	37.8	34.4	30.8	27.0	23.0	18.8	14.4	09.8	05.0	00	05.2	10.6	16.2
180	64.8	62.9	60.8	58.5	56.0	53.3	50.4	47.3	44.0	40.5	36.8	32.9	28.8	24.5	20.0	15.3	10.4	05.3	00	05.5	11.2
190	72.2	70.2	68.0	65.6	63.0	60.2	57.2	54.0	50.6	47.0	43.2	39.2	35.0	30.6	26.0	21.2	16.2	11.0	05.6	00	05.8
200	80.0	77.9	75.6	73.1	70.4	67.5	64.4	61.1	57.6	53.9	50.0	45.9	41.6	37.1	32.4	27.5	22.4	17.1	11.6	05.9	00

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
	40.0	44.1	48.4	52.9	57.6	62.5	67.6	72.9	78.4	84.1	90.0	96.1	102.4	108.9	115.6	122.5	129.6	136.9	144.4	152.1	160.0
10	41.8	46.0	50.4	55.0	59.8	64.8	70.0	75.4	81.0	86.8	92.8	99.0	105.4	112.0	118.8	125.8	133.0	140.4	148.0	155.8	163.8
20	43.2	47.5	52.0	56.7	61.6	66.7	72.0	77.5	83.2	89.1	95.2	101.5	108.0	114.7	121.6	128.7	136.0	143.5	151.2	159.1	167.2
30	44.2	48.6	53.2	58.0	63.0	68.2	73.6	79.2	85.0	91.0	97.2	103.6	110.2	117.0	124.0	131.2	138.6	146.2	154.0	162.0	170.2
40	44.8	49.3	54.0	58.9	64.0	69.3	74.8	80.5	86.4	92.5	98.8	105.3	112.0	118.9	126.0	133.3	140.8	148.5	156.4	164.5	172.8
50	45.0	49.6	54.4	59.4	64.6	70.0	75.6	81.4	87.4	93.6	100.0	106.6	113.4	120.4	127.6	135.0	142.6	150.4	158.4	166.6	175.0
60	44.8	49.5	54.4	59.5	64.8	70.3	76.0	81.9	88.0	94.3	100.8	107.5	114.4	121.5	128.8	136.3	144.0	151.9	160.0	168.3	176.8
70	44.2	49.0	54.0	59.2	64.6	70.2	76.0	82.0	88.2	94.6	101.2	108.0	115.0	122.2	129.6	137.2	145.0	153.0	161.2	169.6	178.2
80	43.2	48.1	53.2	58.5	64.0	69.7	75.6	81.7	88.0	94.5	101.2	108.1	115.2	122.5	130.0	137.7	145.6	153.7	162.0	170.5	179.2
90	41.8	46.8	52.0	57.4	63.0	68.8	74.8	81.0	87.4	94.0	100.8	107.8	115.0	122.4	130.0	137.8	145.8	154.0	162.4	171.0	179.8
100	40.0	45.1	50.4	55.9	61.6	67.5	73.6	79.9	86.4	93.1	100.0	107.1	114.4	121.9	129.6	137.5	145.6	153.9	162.4	171.1	180.0
110	37.8	43.0	48.4	54.0	59.8	65.8	72.0	78.4	85.0	91.8	98.8	106.0	113.4	121.0	128.8	136.8	145.0	153.4	162.0	170.8	179.8
120	35.2	40.5	46.0	51.7	57.6	63.7	70.0	76.5	83.2	90.1	97.2	104.5	112.0	119.7	127.6	135.7	144.0	152.5	161.2	170.1	179.2
130	32.2	37.6	43.2	49.0	55.0	61.2	67.6	74.2	81.0	88.0	95.2	102.6	110.2	118.0	126.0	134.2	142.6	151.2	160.0	169.0	178.2
140	28.8	34.3	40.0	45.9	52.0	58.3	64.8	71.5	78.4	85.5	92.8	100.3	108.0	115.9	124.0	132.3	140.8	149.5	158.4	167.5	176.8
150	25.0	30.6	36.4	42.4	48.6	55.0	61.6	68.4	75.4	82.6	90.0	97.6	105.4	113.4	121.6	130.0	138.6	147.4	156.4	165.6	175.0
160	20.8	26.5	32.4	38.5	44.8	51.3	58.0	64.9	72.0	79.3	86.8	94.5	102.4	110.5	118.8	127.3	136.0	144.9	154.0	163.3	172.8
170	16.2	22.0	28.0	34.2	40.6	47.2	54.0	61.0	68.2	75.6	83.2	91.0	99.0	107.2	115.6	124.2	133.0	142.0	151.2	160.6	170.2
180	11.2	17.1	23.2	29.5	36.0	42.7	49.6	56.7	64.0	71.5	79.2	87.1	95.2	103.5	112.0	120.7	129.6	138.7	148.0	157.5	167.2
190	5.8	11.8	18.0	24.4	31.0	37.8	44.8	52.0	59.4	67.0	74.8	82.8	91.0	99.4	108.0	116.8	125.8	135.0	144.4	154.0	163.8
200	00	6.1	12.4	18.9	25.6	32.5	39.6	46.9	54.4	62.1	70.0	78.1	86.4	94.9	103.6	112.5	121.6	130.9	140.4	150.1	160.0

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
	160.0	168.1	176.4	184.9	193.6	202.5	211.6	220.9	230.3	240.0	249.9	259.9	270.2	280.7	291.4	302.3	313.4	324.6	336.1	347.8	359.7
10	163.8	172.0	180.4	189.0	197.8	206.8	216.0	225.4	235.0	244.7	254.7	264.9	275.2	285.8	296.6	307.6	318.8	330.2	341.7	353.5	365.5
20	167.2	175.5	184.0	192.7	201.6	210.7	220.0	229.5	239.2	249.1	259.1	269.4	279.9	290.5	301.4	312.5	323.8	335.3	347.0	358.8	370.9
30	170.2	178.6	187.2	196.0	205.0	214.2	223.6	233.2	243.0	253.0	263.2	273.5	284.1	294.9	305.8	317.0	328.4	340.0	351.8	363.8	375.9
40	172.8	181.3	190.0	198.9	208.0	217.3	226.8	236.5	246.4	256.5	266.8	277.3	287.9	298.8	309.9	321.1	332.6	344.3	356.2	368.3	380.6
50	175.0	183.6	192.4	201.4	210.6	220.0	229.6	239.4	249.4	259.6	270.0	280.6	291.4	302.3	313.5	324.9	336.4	348.2	360.2	372.4	384.8
60	176.8	185.5	194.4	203.5	212.8	222.3	232.0	241.9	252.0	263.3	272.8	283.5	294.4	305.5	316.7	328.2	339.9	351.7	363.8	376.1	388.6
70	178.2	187.0	196.0	205.2	214.6	224.2	234.0	244.0	254.2	264.6	275.2	286.0	297.0	308.2	319.6	331.1	342.9	354.9	367.0	379.4	392.0
80	179.2	188.1	197.2	206.5	216.0	225.7	235.6	245.7	256.0	266.5	277.2	288.1	299.2	310.5	322.0	333.7	345.5	357.6	369.9	382.3	395.0
90	179.8	188.8	198.0	207.4	217.0	226.8	236.8	247.0	257.4	268.0	278.8	289.8	301.0	312.4	324.0	335.8	347.8	359.9	372.3	384.9	397.6
100	180.0	189.1	198.4	207.9	217.6	227.5	237.6	247.9	258.4	269.1	280.0	291.1	302.4	313.9	325.6	337.5	349.6	361.9	374.3	387.0	399.9
110	179.8	189.0	198.4	208.0	217.8	227.8	238.0	248.4	259.0	269.8	280.8	292.0	303.4	315.0	326.8	338.8	351.0	363.4	376.0	388.7	401.7
120	179.2	188.5	198.0	207.7	217.6	227.7	238.0	248.5	259.2	270.1	281.2	292.5	304.0	315.7	327.6	339.7	352.0	364.5	377.2	390.1	403.1
130	178.2	187.6	197.2	207.0	217.0	227.2	237.6	248.2	259.0	270.0	281.2	292.6	304.2	316.0	328.0	340.2	352.6	365.2	378.0	391.0	404.2
140	176.8	186.3	196.0	205.9	216.0	226.3	236.8	247.5	258.4	269.5	280.8	292.3	304.0	315.9	328.0	340.3	352.8	365.5	378.4	391.5	404.8
150	175.0	184.6	194.4	204.4	214.6	225.0	235.6	246.4	257.4	268.6	280.0	291.6	303.4	315.4	327.6	340.0	352.6	365.4	378.4	391.6	405.0
160	172.8	182.5	192.4	202.5	212.8	223.3	234.0	244.9	256.0	267.3	278.8	290.5	302.4	314.5	326.8	339.3	352.0	364.9	378.0	391.3	404.8
170	170.2	180.0	190.0	200.2	210.6	221.2	232.0	243.0	254.2	265.6	277.2	289.0	301.0	313.2	325.6	338.2	351.0	364.0	377.2	390.6	404.2
180	167.2	177.1	187.2	197.5	208.0	218.7	229.6	240.7	252.0	263.5	275.2	287.1	299.2	311.5	324.0	336.7	349.6	362.7	376.0	389.5	403.2
190	163.8	173.8	184.0	194.4	205.0	215.8	226.8	238.0	249.4	261.0	272.8	284.8	297.0	309.4	322.0	334.8	347.8	361.0	374.4	388.0	401.8
200	160.0	170.1	180.4	190.9	201.6	212.5	223.6	234.9	246.4	258.1	270.0	282.1	294.4	306.9	319.6	332.5	345.6	358.9	372.4	386.1	400.0

		10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
210	88.2	86.0	83.6	81.0	78.2	75.2	72.0	68.6	65.0	61.2	57.2	53.0	48.6	44.0	39.2	34.2	29.0	23.6	18.0	12.2	6.2
220	96.8	94.5	92.0	89.3	86.4	83.3	80.0	76.5	72.8	68.9	64.8	60.5	56.0	51.3	46.4	41.3	36.0	30.5	24.8	18.9	12.8
230	105.8	103.4	100.8	98.0	95.0	91.8	88.4	84.8	81.0	77.0	72.8	68.4	63.8	59.0	54.0	48.8	43.4	37.8	32.0	26.0	19.8
240	115.2	112.7	110.0	107.1	104.0	100.7	97.2	93.5	89.6	85.5	81.2	76.7	72.0	67.1	62.0	56.7	51.2	45.5	39.6	33.5	27.2
250	125.0	122.4	119.6	116.6	113.4	110.0	106.4	102.6	98.6	94.4	90.0	85.4	80.6	75.6	70.4	65.0	59.4	53.6	47.6	41.4	35.0
260	135.2	132.5	129.6	126.5	123.2	119.7	116.0	112.1	108.0	103.7	99.2	94.5	89.6	84.5	79.2	73.7	68.0	62.1	56.0	49.7	43.2
270	145.8	143.0	140.0	136.8	133.4	129.8	126.0	122.0	117.8	113.4	108.8	104.0	99.0	93.8	88.4	82.8	77.0	71.0	64.8	58.4	51.8
280	156.8	153.9	150.8	147.5	144.0	140.3	136.4	132.3	128.0	123.5	118.8	113.9	108.8	103.5	98.0	92.3	86.4	80.3	74.0	67.5	60.8
290	168.2	165.2	162.0	158.6	155.0	151.2	147.2	143.0	138.6	134.0	129.2	124.2	119.0	113.6	108.0	102.2	96.2	90.0	83.6	77.0	70.2
300	180.0	176.9	173.6	170.1	166.4	162.5	158.4	154.1	149.6	144.9	140.0	134.9	129.6	124.1	118.4	112.5	106.4	100.1	93.6	86.9	80.0
310	192.2	189.0	185.6	182.0	178.2	174.2	170.0	165.6	161.0	156.2	151.2	146.0	140.6	135.0	129.2	123.2	117.0	110.6	104.0	97.2	90.2
320	204.8	201.5	198.0	194.3	190.4	186.3	182.0	177.5	172.8	167.9	162.8	157.5	152.0	146.3	140.4	134.3	128.0	121.5	114.8	107.9	100.8
330	217.8	214.4	210.8	207.0	203.0	198.8	194.4	189.8	185.0	180.0	174.8	169.4	163.8	158.0	152.0	145.8	139.4	132.8	126.0	119.0	111.8
340	231.2	227.7	224.0	220.1	216.0	211.7	207.2	202.5	197.6	192.5	187.2	181.7	176.0	170.1	164.0	157.7	151.2	144.5	137.6	130.5	123.2
350	245.0	241.4	237.6	233.6	229.4	225.0	220.4	215.6	210.6	205.4	200.0	194.4	188.6	182.6	176.4	170.0	163.4	156.6	149.6	142.4	135.0
360	259.2	255.5	251.6	247.5	243.2	238.7	234.0	229.1	224.0	218.7	213.2	207.5	201.6	195.5	189.2	182.7	176.0	169.1	162.0	154.7	147.2
370	273.8	270.0	266.0	261.8	257.4	252.8	248.0	243.0	237.8	232.4	226.8	221.0	215.0	208.8	202.4	195.8	189.0	182.0	174.8	167.4	159.8
380	288.8	284.9	280.8	276.5	272.0	267.3	262.4	257.3	252.0	246.5	240.8	234.9	228.8	222.5	216.0	209.3	202.4	195.3	188.0	180.5	172.8
390	304.2	300.2	296.0	291.6	287.0	282.2	277.2	272.0	266.6	261.0	255.2	249.2	243.0	236.6	230.0	223.2	216.2	209.0	201.6	194.0	186.2
400	320.0	315.9	311.6	307.1	302.4	297.5	292.4	287.1	281.6	275.9	270.0	263.9	257.6	251.1	244.4	237.5	230.4	223.1	215.6	207.9	200.0

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
210	6.2	00	6.4	13.0	19.8	26.8	34.0	41.4	49.0	56.8	64.8	73.0	81.4	90.0	98.8	107.8	117.0	126.4	136.0	145.8	155.8
220	12.8	6.5	00	6.7	13.6	20.7	28.0	35.5	43.2	51.1	59.2	67.5	76.0	84.7	93.6	102.7	112.0	121.5	131.2	141.1	151.2
230	19.8	13.4	6.8	00	7.0	14.2	21.6	29.2	37.0	45.0	53.2	61.6	70.2	79.0	88.0	97.2	106.6	116.2	126.0	136.0	146.2
240	27.2	20.7	14.0	7.1	00	7.3	14.8	22.5	30.4	38.5	46.8	55.3	64.0	72.9	82.0	91.3	100.8	110.5	120.4	130.5	140.8
250	35.0	28.4	21.6	14.6	7.4	00	7.6	15.4	23.4	31.6	40.0	48.6	57.4	66.4	75.6	85.0	94.6	104.4	114.4	124.6	135.0
260	43.2	36.5	29.6	22.5	15.2	7.7	00	7.9	16.0	24.3	32.8	41.5	50.4	59.5	68.8	78.3	88.0	97.9	108.0	118.3	128.8
270	51.3	45.0	38.0	30.8	23.4	15.8	8.0	00	8.2	16.6	25.2	34.0	43.0	52.2	61.6	71.2	81.0	91.0	101.2	111.6	122.2
280	60.8	53.9	46.8	39.5	32.0	24.3	16.4	8.3	00	8.5	17.2	26.1	35.2	44.5	54.0	63.7	73.6	83.7	94.0	104.5	115.2
290	70.2	63.2	56.0	48.6	41.0	33.2	25.2	17.0	8.6	00	8.8	17.8	27.0	36.4	46.0	55.8	65.8	76.0	86.4	97.0	107.8
300	80.0	72.9	65.6	58.1	50.4	42.5	34.4	26.1	17.6	8.9	00	9.1	18.4	27.9	37.6	47.5	57.6	67.9	78.4	89.1	100.0
310	90.2	83.0	75.6	68.0	60.2	52.2	44.0	35.6	27.0	18.2	9.2	00	9.4	19.0	28.8	38.8	49.0	59.4	70.0	80.8	91.8
320	100.8	93.5	86.0	78.3	70.4	62.3	54.0	45.5	36.8	27.9	18.8	9.5	00	9.7	19.6	29.7	40.0	50.5	61.2	72.1	83.2
330	111.8	104.4	96.8	89.0	81.0	72.8	64.4	55.8	47.0	38.0	28.8	19.4	9.8	00	10.0	20.2	30.6	41.2	52.0	63.0	74.2
340	123.2	115.7	108.0	100.1	92.0	83.7	75.2	66.5	57.6	48.5	39.2	29.7	20.0	10.1	00	10.3	20.8	31.5	42.4	53.5	64.8
350	135.0	127.4	119.6	111.6	103.4	95.0	86.4	77.6	68.6	59.4	50.0	40.4	30.6	20.6	10.4	00	10.6	21.4	32.4	43.6	55.0
360	147.2	139.5	131.6	123.5	115.2	106.7	98.0	89.1	80.0	70.7	61.2	51.5	41.6	31.5	21.2	10.7	00	10.9	22.0	33.3	44.8
370	159.8	152.0	144.0	135.8	127.4	118.8	110.0	101.0	91.8	82.4	72.8	63.0	53.0	42.8	32.4	21.8	11.0	00	11.2	22.6	34.2
380	172.8	164.9	156.8	148.5	140.0	131.3	122.4	113.3	104.0	94.5	84.8	74.9	64.8	54.5	44.0	33.3	22.4	11.3	00	11.5	23.2
390	186.2	178.2	170.0	161.6	153.0	144.2	135.2	126.0	116.6	107.0	97.2	87.2	77.0	66.6	56.0	45.2	34.2	23.0	11.6	00	11.8
400	200.0	191.9	183.6	175.1	166.4	157.5	148.4	139.1	129.6	119.9	110.0	99.9	89.6	79.1	68.4	57.5	46.4	35.1	23.6	11.9	00

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
210	155.8	166.0	176.4	187.0	197.8	208.8	220.0	231.4	243.0	254.8	266.8	279.0	291.4	304.0	316.8	329.8	343.0	356.4	370.0	383.8	397.8
220	151.2	161.5	172.0	182.7	193.6	204.7	216.0	227.5	239.2	251.1	263.2	275.5	288.0	300.7	313.6	326.7	340.0	353.5	367.2	381.1	395.2
230	146.2	156.6	167.2	178.0	189.0	200.2	211.6	223.2	235.0	247.0	259.2	271.6	284.2	297.0	310.0	323.2	336.6	350.2	364.0	378.0	392.2
240	140.8	151.3	162.0	172.9	184.0	195.3	206.8	218.5	230.4	242.5	254.8	267.3	280.0	292.9	306.0	319.3	332.8	346.5	360.4	374.5	388.8
250	135.0	145.6	156.4	167.4	178.6	190.0	201.6	213.4	225.4	237.6	250.0	263.6	275.4	288.4	301.6	315.0	328.6	342.4	356.4	370.6	385.0
260	128.8	139.5	150.4	161.5	172.8	184.3	196.0	207.9	220.0	232.3	244.8	257.5	270.4	283.5	296.8	310.3	324.0	337.9	352.0	366.3	380.8
270	122.2	133.0	144.0	155.2	166.6	178.2	190.0	202.0	214.2	226.6	239.2	252.0	265.0	278.2	291.6	305.2	319.0	333.0	347.2	361.6	376.2
280	115.2	126.1	137.2	148.5	160.0	171.7	183.6	195.7	208.0	220.5	233.2	246.1	259.2	272.5	286.0	299.7	313.6	327.7	342.0	356.5	371.2
290	107.8	118.8	130.0	141.4	153.0	164.8	176.8	189.0	201.4	214.0	226.8	239.8	253.0	266.4	280.0	293.8	307.8	322.0	336.4	351.0	365.8
300	100.0	111.1	122.4	133.9	145.6	157.5	169.6	181.9	194.4	207.1	220.0	233.1	246.4	259.9	273.6	287.5	301.6	315.9	330.4	345.1	360.0
310	91.8	103.0	114.4	126.0	137.8	149.8	162.0	174.4	187.0	199.8	212.8	226.0	239.4	253.0	266.8	280.8	295.0	309.4	324.0	338.8	353.8
320	83.2	94.5	106.0	117.7	129.6	141.7	154.0	166.5	179.2	192.1	205.2	218.5	232.0	245.7	259.6	273.7	288.0	302.5	317.2	332.1	347.2
330	74.2	85.6	97.2	109.0	121.0	133.2	145.6	158.2	171.0	184.0	197.2	210.6	224.2	238.0	252.0	266.2	280.6	295.2	310.0	325.0	340.2
340	64.8	76.3	88.0	99.9	112.0	124.3	136.8	149.5	162.4	175.5	188.8	202.3	216.0	229.9	244.0	258.3	272.8	287.5	302.4	317.5	332.8
350	55.0	66.6	78.4	90.4	102.6	115.0	127.6	140.4	153.4	166.6	180.0	193.6	207.4	221.4	235.6	250.0	264.6	279.4	294.4	309.6	325.0
360	44.8	56.5	68.4	80.5	92.8	105.3	118.0	130.9	144.0	157.3	170.8	184.5	198.4	212.5	226.8	241.3	256.0	270.9	286.0	301.3	316.8
370	34.2	46.0	58.0	70.2	82.6	95.2	108.0	121.0	134.2	147.6	161.2	175.0	189.0	203.2	217.6	232.2	247.0	262.0	277.2	292.6	308.2
380	23.2	35.1	47.2	59.5	72.0	84.7	97.6	110.7	124.0	137.5	151.2	165.1	179.2	193.5	208.0	222.7	237.6	252.7	268.0	283.5	299.2
390	11.8	23.8	36.0	48.4	61.0	73.8	86.8	100.0	113.4	127.0	140.8	154.8	169.0	183.4	198.0	212.8	227.8	243.0	258.4	274.0	289.8
400	00	12.1	24.4	36.9	49.6	62.5	75.6	88.9	102.4	116.1	130.0	144.1	158.4	172.9	187.6	202.5	217.6	232.9	248.4	264.1	280.0

		10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
410	336.2	332.0	327.6	323.0	318.2	313.2	308.0	302.6	297.0	291.2	285.2	279.0	272.6	266.0	259.2	252.2	245.0	237.6	230.0	222.2	214.2
420	352.8	348.5	344.0	339.3	334.4	329.3	324.0	318.5	312.8	306.9	300.8	294.5	288.0	281.3	274.4	267.3	260.0	252.5	244.8	236.9	228.8
430	369.8	365.4	360.8	356.0	351.0	345.8	340.4	334.8	329.0	323.0	316.8	310.4	303.8	297.0	290.0	282.8	275.4	267.8	260.0	252.0	243.8
440	387.2	382.7	378.0	373.1	368.0	362.7	357.2	351.5	345.6	339.5	333.2	326.7	320.0	313.1	306.0	298.7	291.2	283.5	275.6	267.5	259.2
450	405.0	400.4	395.6	390.6	385.4	380.0	374.4	368.6	362.6	356.4	350.0	343.4	336.6	329.6	322.4	315.0	307.4	299.6	291.6	283.4	275.0
460	423.2	418.5	413.6	408.5	403.2	397.7	392.0	386.1	380.0	373.7	367.2	360.5	353.6	346.5	339.2	331.7	324.0	316.1	308.0	299.7	291.2
470	441.8	437.0	432.0	426.8	421.4	415.8	410.0	404.0	397.8	391.4	384.8	378.0	371.0	363.8	356.4	348.8	341.0	333.0	324.8	316.4	307.8
480	460.8	455.9	450.8	445.5	440.0	434.3	428.4	422.3	416.0	409.5	402.8	395.9	388.8	381.5	374.0	366.3	358.4	350.3	342.0	333.5	324.8
490	480.3	475.2	470.0	464.6	459.0	453.2	447.2	441.0	434.6	428.0	421.2	414.2	407.0	399.6	392.0	384.2	376.2	368.0	359.6	351.0	342.2
500	500.1	494.9	489.6	484.1	478.4	472.5	466.4	460.1	453.6	446.9	440.0	432.9	425.6	418.1	410.4	402.5	394.4	386.1	377.6	368.9	360.0
510	520.3	515.1	509.6	504.0	498.2	492.2	486.0	479.6	473.0	466.2	459.2	452.0	444.6	437.0	429.2	421.2	413.0	404.6	396.0	387.2	378.2
520	540.9	535.6	530.1	524.3	518.4	512.3	506.0	499.5	492.8	485.9	478.8	471.5	464.0	456.3	448.4	440.3	432.0	423.5	414.8	405.9	396.8
530	561.9	556.5	550.9	545.1	539.0	532.8	526.4	519.8	513.0	506.0	498.8	491.4	483.8	476.0	468.0	459.8	451.4	442.8	434.0	425.0	415.8
540	583.3	577.8	572.1	566.2	560.1	553.7	547.2	540.5	533.6	526.5	519.2	511.7	504.0	496.1	488.0	479.7	471.2	462.5	453.6	444.5	435.2
550	605.1	599.5	593.7	587.7	581.5	575.1	568.4	561.6	554.6	547.4	540.0	532.4	524.6	516.6	508.4	500.0	491.4	482.6	473.6	464.4	455.0
560	627.3	621.6	615.7	609.6	603.3	596.8	590.1	583.1	576.0	568.7	561.2	553.5	545.6	537.5	529.2	520.7	512.0	503.1	494.0	484.7	475.2
570	650.0	644.1	638.1	631.9	625.5	618.9	612.1	605.1	597.8	590.4	582.8	575.0	567.0	558.8	550.4	541.8	533.0	524.0	514.8	505.4	495.8
580	673.0	667.1	660.9	654.6	648.1	641.4	634.5	627.4	620.1	612.5	604.8	596.9	588.8	580.5	572.0	563.3	554.4	545.3	536.0	526.5	516.8
590	696.4	690.4	684.2	677.7	671.1	664.3	657.3	650.1	642.7	635.1	627.2	619.2	611.0	602.6	594.0	585.2	576.2	567.0	557.6	548.0	538.2
600	720.2	714.1	707.8	701.3	694.5	687.6	680.5	673.2	665.7	658.0	650.1	641.9	633.6	625.1	616.4	607.5	598.4	589.1	579.6	569.9	560.0

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
410	214.2	206.0	197.6	189.0	180.2	171.2	162.0	152.6	143.0	133.2	123.2	113.0	102.6	92.0	81.2	70.2	59.0	47.6	36.0	24.2	12.2
420	228.8	220.5	212.0	203.3	194.4	185.3	176.0	166.5	156.8	146.9	136.8	126.5	116.0	105.3	94.4	83.3	72.0	60.5	48.8	36.9	24.8
430	243.8	235.4	226.8	218.0	209.0	199.8	190.4	180.8	171.0	161.0	150.8	140.4	129.8	119.0	108.0	96.8	85.4	73.8	62.0	50.0	37.8
440	259.2	250.7	242.0	233.1	224.0	214.7	205.2	195.5	185.6	175.5	165.2	154.7	144.0	133.1	122.0	110.7	99.2	87.5	75.6	63.5	51.2
450	275.0	266.4	257.6	248.6	239.4	230.0	220.4	210.6	200.6	190.4	180.0	169.4	158.6	147.6	136.4	125.0	113.4	101.6	89.6	77.4	65.0
460	291.2	282.5	273.6	264.5	255.2	245.7	236.0	226.1	216.0	205.7	195.2	184.5	173.6	162.5	151.2	139.7	128.0	116.1	104.0	91.7	79.2
470	307.8	299.0	290.0	280.8	271.4	261.8	252.0	242.0	231.8	221.4	210.8	200.0	189.0	177.8	166.4	154.8	143.0	131.0	118.8	106.4	93.8
480	324.8	315.9	306.8	297.5	288.0	278.3	268.4	258.3	248.0	237.5	226.8	215.9	204.8	193.5	182.0	170.3	158.4	146.3	134.0	121.5	108.8
490	342.2	333.2	324.0	314.6	305.0	295.2	285.2	275.0	264.6	254.0	243.2	232.2	221.0	209.6	198.0	186.2	174.2	162.0	149.6	137.0	124.2
500	360.0	350.9	341.6	332.1	322.4	312.5	302.4	292.1	281.6	270.9	260.0	248.9	237.6	226.1	214.4	202.5	190.4	178.1	165.6	152.9	140.0
510	378.2	369.0	359.6	350.0	340.2	330.2	320.0	309.6	299.0	288.2	277.2	266.0	254.6	243.0	231.2	219.2	207.0	194.6	182.0	169.2	156.2
520	396.8	387.5	378.0	368.3	358.4	348.3	338.0	327.5	316.8	305.9	294.8	283.5	272.0	260.3	248.4	236.3	224.0	211.5	198.8	185.9	172.8
530	415.8	406.4	396.8	387.0	377.0	366.8	356.4	345.8	335.0	324.0	312.8	301.4	289.8	278.0	266.0	253.8	241.4	228.8	216.0	203.0	189.8
540	435.2	425.7	416.0	406.1	396.0	385.7	375.2	364.5	353.6	342.5	331.2	319.7	308.0	296.1	284.0	271.7	259.2	246.5	233.6	220.5	207.2
550	455.0	445.4	435.6	425.6	415.4	405.0	394.4	383.6	372.6	361.4	350.0	338.4	326.6	314.6	302.4	290.0	277.4	264.6	251.6	238.4	225.0
560	475.2	465.5	455.6	445.5	435.2	424.7	414.0	403.1	392.0	380.7	369.2	357.5	345.6	333.5	321.2	308.7	296.0	283.1	270.0	256.7	243.2
570	495.8	486.0	476.0	465.8	455.4	444.8	434.0	423.0	411.8	400.0	388.8	377.0	365.0	352.8	340.4	327.8	315.0	302.0	288.8	275.4	261.8
580	516.8	506.9	496.8	486.5	476.0	465.3	454.4	443.3	432.0	420.5	408.8	396.9	384.8	372.5	360.0	347.3	334.4	321.3	308.0	294.5	280.8
590	538.2	528.2	518.0	507.6	497.0	486.2	475.2	464.0	452.6	441.0	429.2	417.2	405.0	392.6	380.0	367.2	354.2	341.0	327.6	314.0	300.2
600	560.0	549.9	539.6	529.1	518.4	507.5	496.4	485.1	473.6	461.9	450.0	437.9	425.6	413.1	400.4	387.5	374.4	361.1	347.6	333.9	320.0

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
410	12.2	00	12.4	25.0	37.8	50.8	64.0	77.4	91.0	104.8	118.8	133.0	147.4	162.0	176.8	191.8	207.0	222.4	238.0	253.8	269.8
420	24.8	12.5	00	12.7	25.6	38.7	52.0	65.5	79.2	93.1	107.2	121.5	136.0	150.7	165.6	180.7	196.0	211.5	227.2	243.1	259.2
430	37.8	25.4	12.8	00	13.0	26.2	39.6	53.2	67.0	81.0	95.2	109.6	124.2	139.0	154.0	169.2	184.6	200.2	216.0	232.0	248.2
440	51.2	38.7	26.0	13.1	00	13.3	26.8	40.5	54.4	68.5	82.8	97.3	112.0	126.9	142.0	157.3	172.8	188.5	204.4	220.5	236.8
450	65.0	52.4	39.6	26.6	13.4	00	13.6	27.4	41.4	55.6	70.0	84.6	99.4	114.4	129.6	145.0	160.6	176.4	192.4	208.6	225.0
460	79.2	66.5	53.6	40.5	27.2	13.7	00	13.9	28.0	42.3	56.8	71.5	86.4	101.5	116.8	132.3	148.0	163.9	180.0	196.3	212.8
470	93.8	81.0	68.0	54.8	41.4	27.8	14.0	00	14.2	28.6	43.2	58.0	73.0	88.2	103.6	119.2	135.0	151.0	167.2	183.6	200.2
480	108.8	95.9	82.8	69.5	56.0	42.3	28.4	14.3	00	14.5	29.2	44.1	59.2	74.5	90.0	105.7	121.6	137.7	154.0	170.5	187.2
490	124.2	111.2	98.0	84.6	71.0	57.2	43.2	29.0	14.6	00	14.8	29.8	45.0	60.4	76.0	91.8	107.8	124.0	140.4	157.0	173.8
500	140.0	126.9	113.6	100.1	86.4	72.5	58.4	44.1	29.6	14.9	00	15.1	30.4	45.9	61.6	77.5	93.6	109.9	126.4	143.1	160.0
510	156.2	143.0	129.6	116.0	102.2	88.2	74.0	59.6	45.0	30.2	15.2	00	15.4	31.0	46.8	62.8	79.0	95.4	112.0	128.8	145.8
520	172.8	159.5	146.0	132.3	118.4	104.3	90.0	75.5	60.8	45.9	30.8	15.5	00	15.7	31.6	47.7	64.0	80.5	97.2	114.1	131.2
530	189.8	176.4	162.8	149.0	135.0	120.8	106.4	91.8	77.0	62.0	46.8	31.4	15.8	00	16.0	32.2	48.6	65.2	82.0	99.0	116.2
540	207.2	193.7	180.0	166.1	152.0	137.7	123.2	108.5	93.6	78.5	63.2	47.7	32.0	16.1	00	16.3	32.8	49.5	66.4	83.5	100.8
550	225.0	211.4	197.6	183.6	169.4	155.0	140.4	125.6	110.6	95.4	80.0	64.4	48.6	32.6	16.4	00	16.6	33.4	50.4	67.6	85.0
560	243.2	229.5	215.6	201.5	287.2	172.7	158.0	143.1	128.0	112.7	97.2	81.5	65.6	49.5	33.2	16.7	00	16.9	34.0	51.3	68.8
570	261.8	248.0	234.0	219.8	205.4	190.8	176.0	161.0	145.8	130.4	114.8	99.0	83.0	66.8	50.4	33.8	17.0	00	17.2	34.6	52.2
580	280.8	266.9	252.8	238.5	224.0	209.3	194.4	179.3	164.0	148.5	132.8	116.9	100.8	84.5	68.0	51.3	34.4	17.3	00	17.5	35.2
590	300.2	286.2	272.0	257.6	243.0	228.2	213.2	198.0	182.6	167.0	151.2	135.2	119.0	102.6	86.0	69.2	52.2	35.0	17.6	00	17.8
600	320.0	305.9	291.6	277.1	262.4	247.5	232.4	217.1	201.6	185.9	170.0	153.9	137.6	121.1	104.4	87.5	70.4	53.1	35.6	17.9	00

TABLE IV

Coefficients of function of Standard Highway Spiral.

To obtain values of any of the functions listed multiply the coefficient by the length of the spiral.

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	$\frac{C}{L}$	$\frac{Y}{L}$	$\frac{X}{L}$
0.0°	0° 00′ 00″	1.000 000	1.000 000	0.000 000
0.1°	0° 02′ 00″	1.000 000	1.000 000	.000 582
0.2°	0° 04′ 00″	1.000 000	0.999 999	.001 164
0.3°	0° 06′ 00″	0.999 999	.999 997	.001 745
0.4°	0° 08′ 00″	.999 998	999 995	.002 327
0.5°	0° 10′ 00″	.999 997	.999 992	.002 909
0.6°	0° 12′ 00″	.999 995	.999 989	.003 491
0.7°	0° 14′ 00″	.999 993	.999 985	.004 072
0.8°	0° 16′ 00″	.999 991	.999 980	.004 654
0.9°	0° 18′ 00″	.999 989	.999 975	.005 236
1.0°	0° 20′ 00″	.999 987	.999 970	.005 818
1.1°	0° 22′ 00″	.999 984	.999 963	.006 399
1.2°	0° 24′ 00″	.999 981	.999 956	.006 981
1.3°	0° 26′ 00″	.999 977	.999 949	.007 563
1.4°	0° 28′ 00″	.999 974	.999 940	.008 145
1.5°	0° 30′ 00″	.999 970	.999 931	.008 726
1.6°	0° 32′ 00″	.999 965	.999 922	.009 308
1.7°	0° 34′ 00″	.999 961	.999 912	.009 890
1.8°	0° 36′ 00″	.999 956	.999 901	.010 471
1.9°	0° 38′ 00″	.999 951	.999 890	.011 053
2.0°	0° 40′ 00″	.999 946	.999 878	.011 635
2.1°	0° 42′ 00″	.999 940	.999 866	.012 216
2.2°	0° 44′ 00″	.999 934	.999 853	.012 798
2.3°	0° 46′ 00″	.999 928	.999 839	.013 379
2.4°	0° 48′ 00″	.999 922	.999 825	.013 961
2.5°	0° 50′ 00″	.999 915	.999 810	.014 542
2.6°	0° 52′ 00″	.999 908	.999 794	.015 124
2.7°	0° 54′ 00″	.999 901	.999 778	.015 705
2.8°	0° 56′ 00″	.999 894	.999 761	.016 287
2.9°	0° 58′ 00″	.999 886	.999 744	.016 868
3.0°	1° 00′ 00″	.999 878	.999 726	.017 450
3.1°	1° 02′ 00″	.999 870	.999 707	.018 031
3.2°	1° 04′ 00″	.999 861	.999 688	.018 613
3.3°	1° 06′ 00″	.999 853	.999 668	.019 194
3.4°	1° 08′ 00″	.999 844	.999 648	.019 775
3.5°	1° 10′ 00″	.999 834	.999 627	.020 357
3.6°	1° 12′ 00″	.999 825	.999 605	.020 938
3.7°	1° 14′ 00″	.999 815	.999 583	.021 519
3.8°	1° 16′ 00″	.999 804	.999 560	.022 101
3.9°	1° 18′ 00″	.999 794	.999 537	.022 682
4.0°	1° 20′ 00″	.999 783	.999 513	.023 263
4.1°	1° 22′ 00″	.999 772	.999 488	.023 844
4.2°	1° 24′ 00″	.999 761	.999 463	.024 425
4.3°	1° 26′ 00″	.999 750	.999 437	.025 006
4.4°	1° 28′ 00″	.999 738	.999 410	.025 587
4.5°	1° 30′ 00″	.999 726	.999 383	.026 168
4.6°	1° 32′ 00″	.999 714	.999 356	.026 749
4.7°	1° 34′ 00″	.999 701	.999 327	.027 330
4.8°	1° 36′ 00″	.999 688	.999 298	.027 911
4.9°	1° 38′ 00″	.999 675	.999 269	.028 492
5.0°	1° 40′ 00″	0.999 662	0.999 239	0.029 073

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.666 667	0.333 333	0.000 000	0.500 000	0.0°
.666 667	.333 333	.000 145	.500 000	0.1°
.666 667	.333 334	.000 291	.500 000	0.2°
.666 668	.333 334	.000 436	.500 000	0.3°
.666 668	.333 335	.000 582	.499 999	0.4°
.666 669	.333 336	.000 727	.499 999	0.5°
.666 670	.333 337	.000 873	.499 998	0.6°
.666 672	.333 338	.001 018	.499,998	0.7°
.666 674	.333 340	.001 164	.499 997	0.8°
.666 675	.333 341	.001 309	.499 996	0.9°
.666 677	.333 343	.001 454	.499 995	1.0°
.666 680	.333 345	.001 600	.499 994	1.1°
.666 682	.333 347	.001 745	.499 993	1.2°
.666 685	.333 350	.001 891	.499 991	1.3°
.666 688	.333 352	.002 036	.499 990	1.4°
.666 691	.333 355	.002 182	.499 989	1.5°
.666 694	.333 358	.002 327	.499 987	1.6°
.666 697	.333 361	.002 472	.499 985	1.7°
.666 701	.333 365	.002 618	.499 984	1.8°
.666 705	.333 368	.002 763	.499 982	1.9°
.666 709	.333 372	.002 909	.499 980	2.0°
.666 714	.333 376	.003 054	.499 978	2.1°
.666 718	.333 380	.003 200	.499 975	2.2°
.666 723	.333 384	.003 345	.499 973	2.3°
.666 728	.333 389	.003 490	.499 971	2.4°
.666 733	.333 394	.003 636	.499 968	2.5°
.666 739	.333 399	.003 781	.499 966	2.6°
.666 744	.333 404	.003 927	.499 963	2.7°
.666 750	.333 409	.004 072	.499 960	2.8°
.666 756	.333 415	.004 218	.499 957	2.9°
.666 762	.333 420	.004 363	.499 954	3.0°
.666 769	.333 426	.004 508	.499 951	3.1°
.666 776	.333 432	.004 654	.499 948	3.2°
.666 783	.333 439	.004 799	.499 945	3.3°
.666 790	.333 445	.004 944	.499 941	3.4°
.666 797	.333 452	.005 090	.499 938	3.5°
.666 805	.333 459	.005 235	.499 934	3.6°
.666 812	.333 466	.005 381	.499 930	3.7°
.666 820	.333 473	.005 526	.499 927	3.8°
.666 828	.333 480	.005 671	.499 923	3.9°
.666 837	.333 488	.005 817	.499 919	4.0°
.666 846	.333 496	.005 962	.499 915	4.1°
.666 854	.333 504	.006 108	.499 910	4.2°
.666 864	.333 512	.006 253	.499 906	4.3°
.666 873	.333 521	.006 398	.499 902	4.4°
.666 882	.333 529	.006 544	.499 897	4.5°
.666 892	.333 538	.006 689	.499 893	4.6°
.666 902	.333 547	.006 834	.499 888	4.7°
.666 912	.333 556	.006 980	.499 883	4.8°
.666 922	.333 566	.007 125	.499 878	4.9°
0.666 933	0.333 575	0.007 270	0.499 873	5.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	$\frac{C}{L}$	$\frac{Y}{L}$	$\frac{X}{L}$
5.0°	1° 40′ 00″	0.999 662	0.999 239	0.029 073
5.1°	1° 42′ 00″	.999 648	.999 208	.029 654
5.2°	1° 44′ 00″	.999 634	.999 177	.030 235
5.3°	1° 46′ 00″	.999 620	.999 145	.030 815
5.4°	1° 48′ 00″	.999 605	.999 112	.031 396
5.5°	1° 49′ 59″	.999 591	.999 079	.031 977
5.6°	1° 51′ 59″	.999 576	.999 045	.032 557
5.7°	1° 53′ 59″	.999 560	.999 011	.033 138
5.8°	1° 55′ 59″	.999 545	.998,976	.033 718
5.9°	1° 57′ 59″	.999 529	.998 940	.034 299
6.0°	1° 59′ 59″	.999 513	.998 904	.034 879
6.1°	2° 01′ 59″	.999 496	.998 867	.035 460
6.2°	2° 03′ 59″	.999 480	.998 830	.036 040
6.3°	2° 05′ 59″	.999 463	.998 792	.036 620
6.4°	2° 07′ 59″	.999 446	.998 753	.037 201
6.5°	2° 09′ 59″	.999 438	.998 714	.037 781
6.6°	2° 11′ 59″	.999 410	.998 674	.038 361
6.7°	2° 13′ 59″	.999 392	.998 633	.038 941
6.8°	2° 15′ 59″	.999 374	.998 592	.039 521
6.9°	2° 17′ 59″	.999 356	.998 551	.040 101
7.0°	2° 19′ 59″	.999 337	.998 508	.040 681
7.1°	2° 21′ 59″	.999 318	.998 466	.041 261
7.2°	2° 23′ 59″	.999 298	.998 422	.041 841
7.3°	2° 25′ 59″	.999 279	.998 378	.042 420
7.4°	2° 27′ 59″	.999 259	.998 333	.043 000
7.5°	2° 29′ 59″	.999 239	.998 288	.043 580
7.6°	2° 31′ 59″	.999 218	.998 242	.044 159
7.7°	2° 33′ 59″	.999 198	.998 195	.044 739
7.8°	2° 35′ 59″	.999 177	.998 148	.045 319
7.9°	2° 37′ 58″	.999 155	.998 101	.045 898
8.0°	2° 39′ 58″	.999 134	.998 052	.046 477
8.1°	2° 41′ 58″	.999 112	.998 003	.047 057
8.2°	2° 43′ 58″	.999 090	.997 954	.047 636
8.3°	2° 45′ 58″	.999 068	.997 904	.048 215
8.4°	2° 47′ 58″	.999 045	.997 853	.048 794
8.5°	2° 49′ 58″	.999 022	.997 801	.049 373
8.6°	2° 51′ 58″	.998 999	.997 749	.049 952
8.7°	2° 53′ 58″	.998 976	.997 697	.050 531
8.8°	2° 55′ 58″	.998 952	.997 644	.051 110
8.9°	2° 57′ 58″	.998 928	.997 590	.051 689
9.0°	2° 59′ 58″	.998 904	.997 535	.052 268
9.1°	3° 01′ 58″	.998 879	.997 480	.052 846
9.2°	3° 03′ 58″	.998 855	.997 425	.053 425
9.3°	3° 05′ 58″	.998 830	.997 369	.054 003
9.4°	3° 07′ 57″	.998 804	.997 312	.054 582
9.5°	3° 09′ 57″	.998 779	.997 254	.055 160
9.6°	3° 11′ 57″	.998 753	.997 196	.055 739
9.7°	3° 13′ 57″	.998 727	.997 138	.056 317
9.8°	3° 15′ 57″	.998 700	.997 078	.056 895
9.9°	3° 17′ 57″	.998 674	.997 019	.057 473
10.0°	3° 19′ 57″	0.998 647	0.996 958	0.058 051

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.666 933	0.333 575	0.007 270	0.499 873	5.0°
.666 944	.333 585	.007 416	.499 868	5.1°
.666 955	.333 595	.007 561	.499 863	5.2°
.666 966	.333 605	.007 706	.499 857	5.3°
.666 977	.333 616	.007 852	.499 852	5.4°
.666 989	.333 626	.007 997	.499 846	5.5°
.667 001	.333 637	.008 142	.499 841	5.6°
.667 013	.336 648	.008 287	.499 835	5.7°
.667 025	.333 659	.008 433	.499 829	5.8°
.667 037	.333 670	.008 578	.499 823	5.9°
.667 050	.333 682	.008 723	.499 817	6.0°
.667 063	.333 694	.008 868	.499 811	6.1°
.667 076	.333 706	.009 014	.499 805	6.2°
.667 089	.333 718	.009 159	.499 799	6.3°
.667 103	.333 730	.009 304	.499 792	6.4°
.667 117	.333 743	.009 450	.499 786	6.5°
.667 131	.333 755	.009 595	.499 779	6.6°
.667 145	.333 768	.009 740	.499 772	6.7°
.667 159	.333 781	.009 885	.499 765	6.8°
.667 174	.333 794	.010 030	.499 758	6.9°
.667 189	.333 808	.010 176	.499 751	7.0°
.667 204	.333 822	.010 321	.499 744	7.1°
.667 219	.333 836	.010 466	.499 737	7.2°
.667 234	.333 850	.010 611	.499 730	7.3°
.667 250	.333 864	.010 756	.499 722	7.4°
.667 266	.333 878	.010 902	.499 715	7.5°
.667 282	.333 893	.011 047	.499 707	7.6°
.667 298	.333 908	.011 192	.499 699	7.7°
.667 315	.333 923	.011 337	.499 691	7.8°
.667 332	.333 938	.011 482	.499 683	7.9°
.667 349	.333 954	.011 627	.499 675	8.0°
.667 366	.333 969	.011 773	.499 667	8.1°
.667 383	.333 985	.011 918	.499 659	8.2°
.667 401	.334 001	.012 063	.499 650	8.3°
.667 419	.334 017	.012 208	.499 642	8.4°
.667 437	.334 034	.012 353	.499 633	8.5°
.667 455	.334 050	.012 498	.499 625	8.6°
.667 474	.334 067	.012 643	.499 616	8.7°
.667 492	.334 084	.012 788	.499 607	8.8°
.667 511	.334 101	.012 933	.499 598	8.9°
.667 530	.334 119	.013 078	.499 589	9.0°
.667 550	.334 136	.013 224	.499 580	9.1°
.667 569	.334 154	.013 369	.499 571	9.2°
.667 589	.334 172	.013 514	.499 561	9.3°
.667 609	.334 190	.013 659	.499 552	9.4°
.667 629	.334 209	.013 804	.499 542	9.5°
.667 650	.334 227	.013 949	.499 532	9.6°
.667 670	.334 246	.014 094	.499 523	9.7°
.667 691	.334 265	.014 239	.499 513	9.8°
.667 712	.334 284	.014 384	.499 503	9.9°
0.667 734	0.334 303	0.014 529	0.499 493	10.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	$\frac{C}{L}$	$\frac{Y}{L}$	$\frac{X}{L}$
10.0°	3° 19′ 57″	0.998 647	0.996 958	0.058 051
10.1°	3° 21′ 57″	.998 620	.996 897	.058 629
10.2°	3° 23′ 57″	.998 592	.996 835	.059 207
10.3°	3° 25′ 57″	.998 564	.996 773	.059 785
10.4°	3° 27′ 57″	.998 536	.996 711	.060 363
10.5°	3° 29′ 56″	.998 508	.996 647	.060 940
10.6°	3° 31′ 56″	.998 480	.996 583	.061 518
10.7°	3° 33′ 56″	.998 451	.996 518	.062 095
10.8°	3° 35′ 56″	.998 422	.996 453	.062 673
10.9°	3° 37′ 56″	.998 392	.996 387	.063 250
11.0°	3° 39′ 56″	.998 363	.996 320	.063 827
11.1°	3° 41′ 56″	.998 333	.996 253	.064 404
11.2°	3° 43′ 56″	.998 303	.996 186	.064 981
11.3°	3° 45′ 56″	.998 272	.996 117	.065 558
11.4°	3° 47′ 55″	.998 242	.996 048	.066 135
11.5°	3° 49′ 55″	.998 211	.995 979	.066 712
11.6°	3° 51′ 55″	.998 179	.995 909	.067 289
11.7°	3° 53′ 55″	.998 148	.995 838	.067 865
11.8°	3° 55′ 55″	.998 116	.995 767	.068 442
11.9°	3° 57′ 55″	.998 084	.995 695	.069 018
12.0°	3° 59′ 55″	.998 052	.995 622	069 595
12.1°	4° 01′ 55″	.998 019	.995 549	.070 171
12.2°	4° 03′ 54″	.997 986	.995 476	.070 747
12.3°	4° 05′ 54″	.997 953	.995 401	.071 323
12.4°	4° 07′ 54″	.997 920	.995 326	.071 899
12.5°	4° 09′ 54″	.997 886	.995 251	.072 475
12.6°	4° 11′ 54″	.997 852	.995 175	.073 051
12.7°	4° 13′ 54″	.997 818	.995 098	.073 627
12.8°	4° 15′ 54″	.997 784	.995 021	.074 202
12.9°	4° 17′ 53″	.997 749	.994 943	.074 778
13.0°	4′ 19° 53″	.997 714	.994 864	.075 353
13.1°	4° 21′ 53″	.997 679	.994 785	.075 929
13.2°	4° 23′ 53″	.997 643	.994 705	.076 504
13.3°	4° 25′ 53″	.997 607	.994 625	.077 079
13.4°	4° 27′ 53″	.997 571	.994 544	.077 654
13.5°	4° 29′ 52″	.997 535	.994 463	.078 229
13.6°	4° 31′ 52″	.997 498	.994 380	.078 804
13.7°	4° 33′ 52″	.997 461	.994 298	.079 378
13.8°	4° 35′ 52″	.997 424	.994 214	.079 953
13.9°	4° 37′ 52″	.997 387	.994 130	.080 528
14.0°	4° 39′ 51″	.997 349	.994 046	.081 102
14.1°	4° 41′ 51″	.997 311	.993 961	.081 676
14.2°	4° 43′ 51″	.997 273	.993 875	.082 251
14.3°	4° 45′ 51″	.997 234	.993 789	.082 825
14.4°	4° 47′ 51″	.997 196	.993 702	.083 399
14.5°	4° 49′ 51″	.997 156	.993 614	.083 972
14.6°	4° 51′ 50″	.997 117	.993 526	.084 546
14.7°	4° 53′ 50″	.997 078	.993 438	.085 120
14.8°	4° 55′ 50″	.997 038	.993 348	.085 693
14.9°	4° 57′ 50″	.996 998	.993 258	.086 267
15.0°	4° 59′ 50″	0.996 957	0.993 168	0.086 840

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.667 734	0.334 303	0.014 529	0.499 493	10.0°
.667 755	.334 323	.014 674	.499 482	10.1°
.667 777	.334 343	.014 819	.499 472	10.2°
.667 799	.334 363	.014 964	.499 462	10.3°
.667 821	.334 383	.015 108	.499 452	10.4°
.667 843	.334 403	.015 253	.449 441	10.5°
.667 866	.334 424	.015 398	.499 430	10.6°
.667 889	.334 444	.015 543	.499 419	10.7°
.667 912	.334 465	.015 688	.499 408	10.8°
.667 935	.334 487	.015 833	.499 397	10.9°
.667 958	.334 508	.015 978	.499 386	11.0°
.667 982	.334 529	.016 123	.499 375	11.1°
.668 006	.334 551	.016 268	.499 364	11.2°
.668 030	.334 573	.016 412	.499 352	11.3°
.668 054	.334 595	.016 557	.499 341	11.4°
.668 079	.334 618	.016 702	.499 329	11.5°
.668 104	.334 640	.016 847	.499 318	11.6°
.668 129	.334 663	.016 992	.499 306	11.7°
.668 154	.334 686	.017 136	.499 294	11.8°
.668 179	.334 709	.017 281	.499 282	11.9°
.668 205	.334 732	.017 426	.499 270	12.0°
.668 231	.334 756	.017 571	.499 258	12.1°
.668 257	.334 779	.017 716	.499 245	12.2°
.668 283	.334 803	.017 860	.499 233	12.3°
.668 310	.334 828	.018 005	.499 220	12.4°
.668 336	.334 852	.018 150	.499 208	12.5°
.668 363	.334 876	.018 294	.499 195	12.6°
.668 390	.334 901	.018 439	.499 182	12.7°
.668 418	.334 926	.018 584	.499 169	12.8°
.668 446	.334 951	.018 728	.499 156	12.9°
.668 473	.334 976	.018 873	.499 143	13.0°
.668 501	.335 002	.019 018	.499 130	13.1°
.668 530	.335 028	.019 162	.499 117	13.2°
.668 558	.335 054	.019 307	.499 103	13.3°
.668 587	.335 080	.019 452	.499 090	13.4°
.668 616	.335 106	.019 596	.499 076	13.5°
.668 645	.335 132	.019 741	.499 062	13.6°
.668 674	.335 159	.019 885	.499 049	13.7°
.668 704	.335 186	.020 030	.499 035	13.8°
.668 734	.335 213	.020 174	.499 021	13.9°
.668 764	.335 240	.020 319	.499 007	14.0°
.668 794	.335 268	.020 463	.498 992	14.1°
.668 824	.335 296	.020 608	.498 978	14.2°
.668 855	.335 324	.020 752	.498 964	14.3°
.668 886	.335 352	.020 897	.498 949	14.4°
.668 917	.335 380	.021 041	.498 934	14.5°
.668 948	.335 409	.021 186	.498 920	14.6°
.668 980	.335 437	.021 330	.498 905	14.7°
.669 012	.335 466	.021 474	.498 890	14.8°
.669 044	.335 495	.021 619	.498 875	14.9°
0.669 076	0.335 525	0.021 763	0.498 860	15.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
15.0°	4° 59′ 50″	0.996 957	0.993 168	0.086 840
15.1°	5° 01′ 49″	.996 916	.993 077	.087 413
15.2°	5° 03′ 49″	.996 875	.992 985	.087 986
15.3°	5° 05′ 49″	.996 834	.992 893	.088 559
15.4°	5° 07′ 49″	.996 793	.992 800	.089 132
15.5°	5° 09′ 48″	.996 751	.992 706	.089 705
15.6°	5° 11′ 48″	.996 709	.992 612	.090 278
15.7°	5° 13′ 48″	.996 667	.992 518	.090 850
15.8°	5° 15′ 48″	.996 624	.992 422	.091 423
15.9°	5° 17′ 48″	.996 582	.992 326	.091 995
16.0°	5° 19′ 47″	.996 538	.992 230	.092 567
16.1°	5° 21′ 47″	.996 495	.992 133	.093 139
16.2°	5° 23′ 47″	.996 452	.992 035	.093 711
16.3°	5° 25′ 47″	.996 408	.991 937	.094 283
16.4°	5° 27′ 46″	.996 363	.991 838	.094 854
16.5°	5° 29′ 46″	.996 319	.991 739	.095 426
16.6°	5° 31′ 46″	.996 274	.991 639	.095 997
16.7°	5° 33′ 46″	.996 229	.991 538	.096 569
16.8°	5° 35′ 45″	.996 184	.991 436	.097 140
16.9°	5° 37′ 45″	.996 139	.991 335	.097 711
17.0°	5° 39′ 45″	.996 093	.991 232	.098 282
17.1°	5° 41′ 44″	.996 047	.991 129	.098 853
17.2°	5° 43′ 44″	.996 000	.991 026	.099 423
17.3°	5° 45′ 44″	.995 954	.990 922	.099 994
17.4°	5° 47′ 44″	.995 907	.990 817	.100 564
17.5°	5° 49′ 43″	.995 860	.990 711	.101 134
17.6°	5° 51′ 43″	.995 813	.990 605	.101 705
17.7°	5° 53′ 43″	.995 765	.990 499	.102 275
17.8°	5° 55′ 43″	.995 717	.990 392	.102 844
17.9°	5° 57′ 42″	.995 669	.990 284	.103 414
18.0°	5° 59′ 42″	.995 620	.990 175	.103 984
18.1°	6° 01′ 42″	.995 572	.990 066	.104 553
18.2°	6° 03′ 41″	.995 523	.989 957	.105 123
18.3°	6° 05′ 41″	.995 473	.989 847	.105 692
18.4°	6° 07′ 41″	.995 424	.989 736	.106 261
18.5°	6° 09′ 40″	.995 374	.989 625	.106 830
18.6°	6° 11′ 40″	.995 324	.989 513	.107 399
18.7°	6° 13′ 40″	.995 274	.989 400	.107 967
18.8°	6° 15′ 39″	.995 223	.989 287	.108 536
18.9°	6° 17′ 39″	.995 172	.989 173	.109 104
19.0°	6° 19′ 39″	.995 121	.989 059	.109 672
19.1°	6° 21′ 38″	.995 070	.988 944	.110 240
19.2°	6° 23′ 38″	.995 018	.988 829	.110 808
19.3°	6° 25′ 38″	.994 966	.988 713	.111 376
19.4°	6° 27′ 37″	.994 914	.988 596	.111 944
19.5°	6° 29′ 37″	.994 861	.988 479	.112 511
19.6°	6° 31′ 37″	.994 809	.988 361	.113 079
19.7°	6° 33′ 36″	.994 756	.988 243	.113 646
19.8°	6° 35′ 36″	.994 702	.988 124	.114 213
19.9°	6° 37′ 36″	.994 649	.988 004	.114 780
20.0°	6° 39′ 35″	0.994 595	0.987 884	0.115 347

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.669 076	0.335 525	0.021 763	0.498 860	15.0°
.669 108	.335 554	.021 908	.498 845	15.1°
.669 141	.335 584	.022 052	.498 829	15.2°
.669 174	.335 614	.022 196	.498 814	15.3°
.669 207	.335 644	.022 341	.498 798	15.4°
.669 240	.335 674	.022 485	.498 783	15.5°
.669 274	.335 705	.022 629	.498 767	15.6°
.669 308	.335 736	.022 774	.498 751	15.7°
.669 342	.335 767	.022 918	.498 735	15.8°
.669 376	.335 798	.023 062	.498 719	15.9°
.669 410	.335 829	.023 206	.498 703	16.0°
.669 445	.335 861	.023 351	.498 687	16.1°
.669 480	.335 892	.023 495	.498 671	16.2°
.669 515	.335 924	.023 639	.498 654	16.3°
.669 550	.335 956	.023 783	.498 638	16.4°
.669 586	.335 989	.023 927	.498 621	16.5°
.669 622	.336 021	.024 072	.498 604	16.6°
.669 658	.336 054	.024 216	.498 587	16.7°
.669 694	.336 087	.024 360	.498 570	16.8°
.669 730	.336 120	.024 504	.498 554	16.9°
.669 767	.336 154	.024 648	.498 536	17.0°
.669 804	.336 187	.024 792	.498 519	17.1°
.669 841	.336 221	.024 936	.498 502	17.2°
.669 878	.336 255	.025 080	.498 484	17.3°
.669 916	.336 289	.025 224	.498 467	17.4°
.669 954	.336 324	.025 368	.498 449	17.5°
.669 992	.336 358	.025 512	.498 432	17.6°
.670 030	.336 393	.025 656	.498 414	17.7°
.670 069	.336 428	.025 800	.498 396	17.8°
.670 107	.336 463	.025 944	.498 378	17.9°
.670 146	.336 499	.026 088	.498 360	18.0°
.670 185	.336 534	.026 232	.498 341	18.1°
.670 225	.336 570	.026 376	.498 323	18.2°
.670 264	.336 606	.026 520	.498 305	18.3°
.670 304	.336 642	.026 663	.498 286	18.4°
.670 344	.336 679	.026 807	.498 267	18.5°
.670 384	.336 716	.026 951	.498 249	18.6°
.670 425	.336 752	.027 095	.498 230	18.7°
.670 466	.336 790	.027 239	.498 211	18.8°
.670 507	.336 827	.027 382	.498 192	18.9°
.670 548	.336 864	.027 526	.498 173	19.0°
.670 589	.336 902	.027 670	.498 154	19.1°
.670 631	.336 940	.027 814	.498 134	19.2°
.670 673	.336 978	.027 957	.498 115	19.3°
.670 715	.337 016	.028 101	.498 095	19.4°
.670 757	.337 055	.028 245	.498 076	19.5°
.670 800	.337 094	.028 388	.498 056	19.6°
.670 842	.337 133	.028 532	.498 036	19.7°
.670 885	.337 172	.028 675	.498 016	19.8°
.670 928	.337 211	.028 819	.497 996	19.9°
0.670 972	0.337 251	0.028 963	0.497 976	20.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
20.0°	6° 39′ 35″	0.994 595	0.987 884	0.115 347
20.1°	6° 41′ 35″	.994 541	.987 763	.115 913
20.2°	6° 43′ 34″	.994 487	.987 642	.116 480
20.3°	6° 45′ 34″	.994 432	.987 520	.117 046
20.4°	6° 47′ 34″	.994 377	.987 397	.117 612
20.5°	6° 49′ 33″	.994 322	.987 274	.118 178
20.6°	6° 51′ 33″	.994 267	.987 150	.118 744
20.7°	6° 53′ 32″	.994 211	.987 026	.119 310
20.8°	6° 55′ 32″	.994 155	.986 901	.119 875
20.9°	6° 57′ 32″	.994 099	.986 776	.120 441
21.0°	6° 59′ 31″	.994 042	.986 650	.121 006
21.1°	7° 01′ 31″	.993 986	.986 523	.121 571
21.2°	7° 03′ 30″	.993 928	.986 396	.122 136
21.3°	7° 05′ 30″	.993 871	.986 268	.122 700
21.4°	7° 07′ 30″	.993 814	.986 140	.123 265
21.5°	7° 09′ 29″	.993 756	.986 011	.123 830
21.6°	7° 11′ 29″	.993 698	.985 881	.124 394
21.7°	7° 13′ 28″	.993 639	.985 751	.124 958
21.8°	7° 15′ 28″	.993 581	.985 620	.125 522
21.9°	7° 17′ 27″	.993 522	.985 489	.126 086
22.0°	7° 19′ 27″	.993 463	.985 357	.126 649
22.1°	7° 21′ 26″	.993 403	.985 224	.127 213
22.2°	7° 23′ 26″	.993 344	.985 091	.127 776
22.3°	7° 25′ 26″	.993 284	.984 958	.128 339
22.4°	7° 27′ 25″	.993 223	.984 823	.128 902
22.5°	7° 29′ 25″	.993 163	.984 688	.129 465
22.6°	7° 31′ 24″	.993 102	.984 553	.130 027
22.7°	7° 33′ 24″	.993 041	.984 417	.130 590
22.8°	7° 35′ 23″	.992 980	.984 280	.131 152
22.9°	7° 37′ 23″	.992 918	.984 143	.131 714
23.0°	7° 39′ 22″	.992 856	.984 006	.132 276
23.1°	7° 41′ 22″	.992 794	.983 867	.132 838
23.2°	7° 43′ 21″	.992 732	.983 728	.133 400
23.3°	7° 45′ 21″	.992 669	.983 589	.133 961
23.4°	7° 47′ 20″	.992 606	.983 449	.134 522
23.5°	7° 49′ 20″	.992 543	.983 308	.135 083
23.6°	7° 51′ 19″	.992 480	.983 167	.135 644
23.7°	7° 53′ 19″	.992 416	.983 025	.136 205
23.8°	7° 55′ 18″	.992 352	.982 883	.136 766
23.9°	7° 57′ 18″	.992 288	.982 740	.137 326
24.0°	7° 59′ 17″	.992 224	.982 596	.137 886
24.1°	8° 01′ 16″	.992 159	.982 452	.138 446
24.2°	8° 03′ 16″	.992 094	.982 307	.139 006
24.3°	8° 05′ 15″	.992 028	.982 162	.139 566
24.4°	8° 07′ 15″	.991 963	.982 016	.140 125
24.5°	8° 09′ 14″	.991 897	.981 869	.140 684
24.6°	8° 11′ 14″	.991 831	.981 722	.141 244
24.7°	8° 13′ 13″	.991 765	.981 575	.141 802
24.8°	8° 15′ 13″	.991 698	.981 427	.142 361
24.9°	8° 17′ 12″	.991 631	.981 278	.142 920
25.0°	8° 19′ 11″	0.991 564	0.981 128	0.143 478

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.670 972	0.337 251	0.028 963	0.497 976	20.0°
.671 016	.337 290	.029 106	.497 956	20.1°
.671 060	.337 330	.029 250	.497 936	20.2°
.671 104	.337 371	.029 393	.497 915	20.3°
.671 118	.337 411	.029 537	.497 895	20.4°
.671 192	.337 452	.029 680	.497 874	20.5°
.671 237	.337 492	.029 823	.497 853	20.6°
.671 282	.337 534	.029 976	.497 832	20.7°
.671 328	.337 575	.030 110	.497 811	20.8°
.671 373	.337 616	.030 254	.497 790	20.9°
.671 419	.337 658	.030 397	.497 769	21.0°
.671 465	.337 700	.030 540	.497 748	21.1°
.671 511	.337 742	.030 684	.497 727	21.2°
.671 558	.337 784	.030 827	.497 706	21.3°
.671 604	.337 827	.030 970	.497 684	21.4°
.671 651	.337 869	.031 114	.497 662	21.5°
.671 698	.337 912	.031 257	.497 641	21.6°
.671 746	.337 955	.031 400	.497 619	21.7°
.671 793	.337 999	.031 543	.497 597	21.8°
.671 841	.338 042	.031 687	.497 575	21.9°
.671 889	.338 086	.031 830	.497 553	22.0°
.671 937	.338 130	.031 973	.497 531	22.1°
.671 986	.338 174	.032 116	.497 508	22.2°
.672 034	.338 219	.032 259	.497 486	22.3°
.672 083	.338 263	.032 402	.497 463	22.4°
.672 133	.338 308	.032 545	.497 441	22.5°
.672 182	.338 353	.032 688	.497 418	22.6°
.672 232	.338 398	.032 831	.497 395	22.7°
.672 282	.338 444	.032 974	.497 372	22.8°
,672 332	.338 489	.033 117	.497 349	22.9°
.672 382	.338 535	.033 260	.497 326	23.0°
.672 433	.338 581	.033 403	.497 303	23.1°
.672 484	.338 628	.033 546	.497 280	23.2°
.672 535	.338 674	.033 689	.497 256	23.3°
.672 586	.338 721	.033 832	.497 233	23.4°
.672 637	.338 768	.033 975	.497 209	23.5°
.672 689	.338 815	.034 118	.497 186	23.6°
.672 741	.338 862	.034 260	.497 162	23.7°
.672 793	.338 910	.034 403	.497 138	23.8°
.672 846	.338 958	.034 546	.497 114	23.9°
.672 899	.339 006	.034 689	.497 090	24.0°
.672 952	.339 054	.034 831	.497 066	24.1°
.673 005	.339 103	.034 974	.497 041	24.2°
.673 058	.339 151	.035 117	.497 017	24.3°
.673 112	.339 200	.035 259	.496 993	24.4°
.673 166	.339 249	.035 402	.496 968	24.5°
.673 220	.339 299	.035 545	.496 943	24.6°
.673 274	.339 348	.035 687	.496 918	24.7°
.673 329	.339 398	.035 830	.496 894	24.8°
.673 384	.339 448	.035 972	.496 869	24.9°
0.673 439	0.339 498	0.036 115	0.496 844	25.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
25.0°	8° 19′ 11″	0.991 564	0.981 128	0.143 478
25.1°	8° 21′ 11″	.991 496	.980 979	.144 036
25.2°	8° 23′ 10″	.991 429	.980 828	.144 594
25.3°	8° 25′ 10″	.991 361	.980 677	.145 152
25.4°	8° 27′ 09″	.991 293	.980 525	.145 710
25.5°	8° 29′ 08″	.991 224	.980 373	.146 267
25.6°	8° 31′ 08″	.991 156	.980 220	.146 824
25.7°	8° 33′ 07″	.991 086	.980 067	.147 382
25.8°	8° 35′ 07″	.991 017	.979 913	.147 938
25.9°	8° 37′ 06″	.990 948	.979 758	.148 495
26.0°	8° 39′ 05″	.990 878	.979 603	.149 052
26.1°	8° 41′ 05″	.990 808	.979 448	.149 608
26.2°	8° 43′ 04″	.990 737	.979 291	.150 164
26.3°	8° 45′ 03″	.990 667	.979 134	.150 720
26.4°	8° 47′ 03″	.990 596	.978 977	.151 276
26.5°	8° 49′ 02″	.990 525	.978 819	.151 831
26.6°	8° 51′ 01″	.990 453	.978 660	.152 386
26.7°	8° 53′ 01″	.990 382	.978 501	.152 941
26.8°	8° 55′ 00″	.990 310	.978 342	.153 496
26.9°	8° 56′ 59″	.990 238	.978 181	.154 051
27.0°	8° 58′ 59″	.990 165	.978 021	.154 606
27.1°	9° 00′ 58″	.990 092	.977 859	.155 160
27.2°	9° 02′ 57″	.990 019	.977 697	.155 714
27.3°	9° 04′ 57″	.989 946	.977 535	.156 268
27.4°	9° 06′ 56″	.989 873	.977 371	.156 822
27.5°	9° 08′ 55″	.989 799	.977 208	.157 375
27.6°	9° 10′ 55″	.989 725	.977 043	.157 928
27.7°	9° 12′ 54″	.989 650	.976 879	.158 482
27.8°	9° 14′ 53″	.989 576	.976 713	.159 034
27.9°	9° 16′ 52″	.989 501	.976 547	.159 587
28.0°	9° 18′ 52″	.989 426	.976 381	.160 140
28.1°	9° 20′ 51″	.989 351	.976 213	.160 692
28.2°	9° 22′ 50″	.989 275	.976 046	.161 244
28.3°	9° 24′ 49″	.989 199	.975 878	.161 796
28.4°	9° 26′ 49″	.989 123	.975 709	.162 347
28.5°	9° 28′ 48″	.989 046	.975 539	.162 899
28.6°	9° 30′ 47″	.988 970	.975 369	.163 450
28.7°	9° 32′ 46″	.988 893	.975 199	.164 001
28.8°	9° 34′ 46″	.988 816	.975 028	.164 552
28.9°	9° 36′ 45″	.988 738	.974 856	.165 103
29.0°	9° 38′ 44″	.988 660	.974 684	.165 653
29.1°	9° 40′ 43″	.988 582	.974 511	.166 203
29.2°	9° 42′ 42″	.988 504	.974 338	.166 753
29.3°	9° 44′ 42″	.988 426	.974 164	.167 303
29.4°	9° 46′ 41″	.988 347	.973 989	.167 852
29.5°	9° 48′ 40″	.988 268	.973 814	.168 402
29.6°	9° 50′ 39″	.988 188	.973 638	.168 951
29.7°	9° 52′ 38″	.988 109	.973 462	.169 500
29.8°	9° 54′ 38″	.988 028	.973 285	.170 048
29.9°	9° 56′ 37″	.987 949	.973 108	.170 597
30.0°	9° 58′ 36″	0.987 868	0.972 930	0.171 145

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.673 439	0.339 498	0.036 115	0.496 844	25.0°
.673 494	.339 549	.036 257	.496 818	25.1°
.673 549	.339 599	.036 400	.496 793	25.2°
.673 605	.339 650	.036 542	.496 768	25.3°
.673 661	.339 701	.036 685	.496 742	25.4°
.673 718	.339 752	.036 827	.496 717	25.5°
.673 774	.339 804	.036 969	.496 691	25.6°
.673 831	.339 856	.037 112	.496 665	25.7°
.673 888	.339 908	.037 254	.496 640	25.8°
.673 945	.339 960	.037 396	.496 614	25.9°
.674 002	.340 012	.037 539	.496 588	26.0°
.674 060	.340 065	.037 681	.496 561	26.1°
.674 118	.340 118	.037 823	.496 535	26.2°
.674 176	.340 171	.037 965	.496 509	26.3°
.674 234	.340 224	.038 107	.496 482	26.4°
.674 293	.340 277	.038 250	.496 456	26.5°
.674 352	.340 331	.038 392	.496 429	26.6°
.674 411	.340 385	.038 534	.496 402	26.7°
.674 470	.340 439	.038 676	.496 376	26.8°
.674 530	.340 494	.038 818	.496 349	26.9°
.674 590	.340 548	.038 960	.496 322	27.0°
.674 650	.340 603	.039 102	.496 294	27.1°
.674 710	.340 658	.039 244	.496 267	27.2°
.674 771	.340 713	.039 386	.496 240	27.3°
.674 832	.340 769	.039 528	.496 212	27.4°
.674 893	.340 824	.039 670	.496 185	27.5°
.674 954	.340 880	.039 812	.496 157	27.6°
.675 016	.340 936	.039 953	.496 130	27.7°
.675 078	.340 993	.040 095	.496 102	27.8°
.675 140	.341 049	.040 237	.496 074	27.9°
.675 202	.341 106	.040 379	.496 046	28.0°
.675 264	.341 163	.040 520	.496 018	28.1°
.675 327	.341 220	.040 662	.495 990	28.2°
.675 390	.341 278	.040 804	.495 961	28.3°
.675 453	.341 336	.040 946	.495 933	28.4°
.675 517	.341 394	.041 087	.495 904	28.5°
.675 580	.341 452	.041 229	.495 876	28.6°
.675 644	.341 510	.041 370	.495 847	28.7°
.675 709	.341 569	.041 512	.495 818	28.8°
.675 773	.341 628	.041 654	.495 790	28.9°
.675 838	.341 687	.041 795	.495 761	29.0°
.675 903	.341 746	.041 936	.495 732	29.1°
.675 968	.341 805	.042 078	.495 702	29.2°
.676 034	.341 865	.042 219	.495 673	29.3°
.676 099	.341 925	.042 361	.495 644	29.4°
.676 165	.341 985	.042 502	.495 614	29.5°
.676 231	.342 046	.042 643	.495 585	29.6°
.676 298	.342 106	.042 785	.495 555	29.7°
.676 365	.342 167	.042 926	.495 525	29.8°
.676 432	.342 228	.043 067	.495 495	29.9°
0.676 499	0.342 290	0.043 208	0.495 465	30.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
30.0°	9° 58′ 36″	0.987 868	0.972 930	0.171 145
30.1°	10° 00′ 35″	.987 788	.972 752	.171 693
30.2°	10° 02′ 34″	.987 707	.972 573	.172 241
30.3°	10° 04′ 33″	.987 626	.972 393	.172 788
30.4°	10° 06′ 32″	.987 544	.972 213	.173 335
30.5°	10° 08′ 32″	.987 462	.972 032	.173 882
30.6°	10° 10′ 31″	.987 380	.971 851	.174 429
30.7°	10° 12′ 30″	.987 298	.971 669	.174 976
30.8°	10° 14′ 29″	.987 216	.971 487	.175 522
30.9°	10° 16′ 28″	.987 133	.971 304	.176 069
31.0°	10° 18′ 27″	.987 050	.971 120	.176 615
31.1°	10° 20′ 26″	.986 967	.970 936	.177 160
31.2°	10° 22′ 25″	.986 883	.970 752	.177 706
31.3°	10° 24′ 24″	.986 799	.970 566	.178 251
31.4°	10° 26′ 23″	.986 715	.970 381	.178 796
31.5°	10° 28′ 23″	.986 631	.970 194	.179 341
31.6°	10° 30′ 22″	.986 546	.970 007	.179 885
31.7°	10° 32′ 21″	.986 461	.969 820	.180 430
31.8°	10° 34′ 20″	.986 376	.969 632	.180 974
31.9°	10° 36′ 19″	.986 291	.969 444	.181 518
32.0°	10° 38′ 18″	.986 205	.969 254	.182 061
32.1°	10° 40′ 17″	.986 119	.969 065	.182 605
32.2°	10° 42′ 16″	.986 033	.968 875	.183 148
32.3°	10° 44′ 15″	.985 946	.968 684	.183 691
32.4°	10° 46′ 14″	.985 860	.968 492	.184 234
32.5°	10° 48′ 13″	.985 773	.968 301	.184 776
32.6°	10° 50′ 12″	.985 686	.968 108	.185 318
32.7°	10° 52′ 11″	.985 598	.967 915	.185 860
32.8°	10° 54′ 10″	.985 510	.967 722	.186 402
32.9°	10° 56′ 09″	.985 422	.967 527	.186 944
33.0°	10° 58′ 08″	.985 334	.967 333	.187 485
33.1°	11° 00′ 07″	.985 246	.967 138	.188 026
33.2°	11° 02′ 06″	.985 157	.966 942	.188 567
33.3°	11° 04′ 05″	.985 068	.966 745	.189 107
33.4°	11° 06′ 04″	.984 978	.966 549	.189 648
33.5°	11° 08′ 03″	.984 889	.966 351	.190 188
33.6°	11° 10′ 02″	.984 799	.966 153	.190 727
33.7°	11° 12′ 01″	.984 709	.965 955	.191 267
33.8°	11° 13′ 59″	.984 618	.965 756	.191 806
33.9°	11° 15′ 58″	.984 528	.965 556	.192 345
34.0°	11° 17′ 57″	.984 437	.965 356	.192 884
34.1°	11° 19′ 56″	.984 346	.965 155	.193 423
34.2°	11° 21′ 55″	.984 254	.964 954	.193 961
34.3°	11° 23′ 54″	.984 162	.964 752	.194 499
34.4°	11° 25′ 53″	.984 071	.964 549	.195 037
34.5°	11° 27′ 52″	.983 978	.964 346	.195 574
34.6°	11° 29′ 51″	.983 886	.964 143	.196 112
34.7°	11° 31′ 50″	.983 793	.963 939	.196 649
34.8°	11° 33′ 48″	.983 700	.963 734	.197 186
34.9°	11° 35′ 47″	.983 607	.963 529	.197 722
35.0°	11° 37′ 46″	0.983 513	0.963 323	0.198 258

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.676 499	0.342 290	0.043 208	0.495 465	30.0°
.676 566	.342 351	.043 350	.495 435	30.1°
.676 634	.342 413	.043 491	.495 405	30.2°
.676 702	.342 475	.043 632	.495 375	30.3°
.676 770	.342 537	.043 773	.495 345	30.4°
.676 838	.342 600	.043 914	.495 314	30.5°
.676 907	.342 662	.044 055	.495 284	30.6°
.676 976	.342 725	.044 196	.495 253	30.7°
.677 045	.342 788	.044 337	.495 222	30.8°
.677 115	.342 852	.044 478	.495 191	30.9°
.677 184	.342 916	.044 619	.495 160	31.0°
.677 254	.342 979	.044 760	.495 129	31.1°
.677 324	.343 043	.044 901	.495 098	31.2°
.677 395	.343 108	.045 042	.495 067	31.3°
.677 466	.343 172	.045 183	.495 036	31.4°
.677 537	.343 237	.045 324	.495 004	31.5°
.677 608	.343 302	.045 464	.494 973	31.6°
.677 679	.343 367	.045 605	.494 941	31.7°
.677 751	.343 433	.045 746	.494 910	31.8°
.677 823	.343 499	.045 886	.494 878	31.9°
.677 895	.343 564	.046 027	.494 846	32.0°
.677 968	.343 631	.046 168	.494 814	32.1°
.678 040	.343 697	.046 308	.494 782	32.2°
.678 113	.343 764	.046 449	.494 750	32.3°
.678 187	.343 831	.046 589	.494 718	32.4°
.678 260	.343 898	.046 730	.494 685	32.5°
.678 334	.343 965	.046 870	.494 653	32.6°
.678 408	.344 033	.047 011	.494 620	32.7°
.678 482	.344 101	.047 151	.494 588	32.8°
.678 557	.344 169	.047 292	.494 555	32.9°
.678 631	.344 237	.047 432	.494 522	33.0°
.678 706	.344 306	.047 572	.494 489	33.1°
.678 782	.344 374	.047 712	.494 456	33.2°
.678 857	.344 443	.047 853	.494 423	33.3°
.678 933	.344 512	.047 993	.494 390	33.4°
.679 009	.344 582	.048 133	.494 356	33.5°
.679 085	.344 652	.048 273	.494 323	33.6°
.679 162	.344 722	.048 414	.494 289	33.7°
.679 239	.344 792	.048 554	.494 256	33.8°
.679 316	.344 862	.048 694	.494 222	33.9°
.679 393	.344 933	.048 834	.494 188	34.0°
.679 471	.345 004	.048 974	.494 154	34.1°
.679 549	.345 075	.049 114	.494 120	34.2°
.679 627	.345 146	.049 254	.494 086	34.3°
.679 705	.345 218	.049 394	.494 052	34.4°
.679 784	.345 290	.049 533	.494 018	34.5°
.679 863	.343 362	.049 673	.493 983	34.6°
.679 942	.345 434	.049 813	.493 949	34.7°
.680 022	.345 507	.049 953	.493 914	34.8°
.680 101	.345 580	.050 093	.493 880	34.9°
0.680 181	0.345 653	0.050 232	0.493 845	35.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	$\frac{C}{L}$	$\frac{Y}{L}$	$\frac{X}{L}$
35.0°	11° 37′ 46″	0.983 513	0.963 324	0.198 258
35.1°	11° 39′ 45″	.983 420	.963 117	.198 794
35.2°	11° 41′ 44″	.983 326	.962 910	.199 330
35.3°	11° 43′ 43″	.983 231	.962 703	.199 866
35.4°	11° 45′ 41″	.983 137	.962 495	.200 401
35.5°	11° 47′ 40″	.983 042	.962 287	.200 936
35.6°	11° 49′ 39″	.982 947	.962 078	.201 471
35.7°	11° 51′ 38″	.982 851	.961 868	.202 005
35.8°	11° 53′ 37″	.982 756	.961 658	.202 540
35.9°	11° 55′ 35″	.982 660	.961 448	.203 074
36.0°	11° 57′ 34″	.982 564	.961 237	.203 607
36.1°	11° 59′ 33″	.982 467	.961 025	.204 141
36.2°	12° 01′ 32″	.982 371	.960 813	.204 674
36.3°	12° 03′ 31″	.982 274	.960 600	.205 207
36.4°	12° 05′ 29″	.982 177	.960 387	205 739
36.5°	12° 07′ 28″	.982 079	.960 173	.206 272
36.6°	12° 09′ 27″	.981 982	.959 958	.206 804
36.7°	12° 11′ 26″	.981 884	.959 743	.207 336
36.8°	12° 13′ 24″	.981 785	.959 528	.207 867
36.9°	12° 15′ 23″	.981 687	.959 312	.208 399
37.0°	12° 17′ 22″	.981 588	.959 095	.208 930
37.1°	12° 19′ 20″	.981 489	.958 878	.209 461
37.2°	12° 21′ 19″	.981 390	.958 661	.209 991
37.3°	12° 23′ 18″	.981 290	.958 442	.210 521
37.4°	12° 25′ 16″	.981 191	.958 224	.211 051
37.5°	12° 27′ 15″	.981 091	.958 004	.211 581
37.6°	12° 29′ 14″	.980 990	.957 785	.212 111
37.7°	12° 31′ 12″	.980 890	.957 564	.212 640
37.8°	12° 33′ 11″	.980 789	.957 343	213 169
37.9°	12° 35′ 10″	.980 688	.957 122	.213 697
38.0°	12° 37′ 08″	.980 587	.956 900	.214 226
38.1°	12° 39′ 07″	.980 485	.956 677	.214 754
38.2°	12° 41′ 06″	.980 383	.956 454	.215 281
38.3°	12° 43′ 04″	.980 281	.956 231	.215 809
38.4°	12° 45′ 03″	.980 179	.956 007	.216 336
38.5°	12° 47′ 01″	.980 076	.955 782	.216 863
38.6°	12° 49′ 00″	.979 973	.955 557	.217 390
38.7°	12° 50′ 59″	.979 870	.955 331	.217 916
38.8°	12° 52′ 57″	.979 767	.955 105	.218 442
38.9°	12° 54′ 56″	.979 663	.954 878	.218 968
39.0°	12° 56′ 54″	.979 559	.954 651	.219 494
39.1°	12° 58′ 53″	.979 455	.954 423	.220 019
39.2°	13° 00′ 51″	.979 350	.954 195	.220 544
39.3°	13° 02′ 50″	.979 246	.953 966	.221 069
39.4°	13° 04′ 49″	.979 141	.953 736	.221 593
39.5°	13° 06′ 47″	.979 036	.953 506	.222 117
39.6°	13° 08′ 46″	.978 930	.953 276	.222 641
39.7°	13° 10′ 44″	.978 824	.953 045	.223 165
39.8°	13° 12′ 43″	.978 718	.952 813	.223 688
39.9°	13° 14′ 41″	.978 612	.952 581	.224 211
40.0°	13° 16′ 40″	0.978 506	0.952 349	0.224 734

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.680 181	0.345 653	0.050 232	0.493 845	35.0°
.680 261	.345 726	.050 372	.493 810	35.1°
.680 342	.345 800	.050 512	.493 775	35.2°
.680 423	.345 874	.050 651	.493 740	35.3°
.680 504	.345 948	.050 791	.493 705	35.4°
.680 585	.346 022	.050 931	.493 670	35.5°
.680 666	.346 097	.051 070	.493 634	35.6°
.680 748	.346 172	.051 210	.493 599	35.7°
.680 830	.346 246	.051 349	.493 563	35.8°
.680 913	.346 322	.051 488	.493 528	35.9°
.680 995	.346 397	.051 628	.493 492	36.0°
.681 078	.346 473	.051 767	.493 456	36.1°
.681 161	.346 549	.051 906	.493 420	36.2°
.681 245	.346 625	.052 046	.493 384	36.3°
.681 328	.346 702	.052 185	.493 348	36.4°
.681 412	.346 779	.052 324	.493 312	36.5°
.681 496	.346 856	.052 464	.493 258	36.6°
.681 581	.346 933	.052 603	.493 239	36.7°
.681 666	.347 010	.052 742	.493 203	36.8°
.681 751	.347 088	.052 881	.493 166	36.9°
.681 836	.347 166	.053 020	.493 130	37.0°
.681 922	.347 244	.053 159	.493 093	37.1°
.682 007	.347 323	.053 298	.493 056	37.2°
.682 094	.347 402	.053 437	.493 019	37.3°
.682 180	.347 481	.053 576	.492 982	37.4°
.682 266	.347 560	.053 715	.492 945	37.5°
.682 353	.347 639	.053 854	.492 908	37.6°
.682 441	.347 719	.053 992	.492 870	37.7°
.682 528	.347 799	.054 131	.492 833	37.8°
.682 616	.347 879	.054 270	.492 795	37.9°
.682 704	.347 960	.054 409	.492 758	38.0°
.682 792	.348 041	.054 547	.492 720	38.1°
.682 881	.348 122	.054 686	.492 682	38.2°
.682 969	.348 203	.054 824	.492 644	38.3°
.683 058	.348 284	.054 963	.492 606	38.4°
.683 148	.348 366	.055 102	.492 568	38.5°
.683 238	.348 448	.055 240	.492 530	38.6°
.683 327	.348 531	.055 379	.492 492	38.7°
.683 418	.348 613	.055 517	.492 454	38.8°
.683 508	.348 696	.055 655	.492 415	38.9°
.683 599	.348 779	.055 794	.492 377	39.0°
.683 690	.348 862	.055 932	.492 338	39.1°
.683 781	.348 946	.056 070	.492 299	39.2°
.683 873	.349 030	.056 209	.492 260	39.3°
.683 965	.349 114	.056 347	.492 222	39.4°
.684 057	.349 198	.056 485	.492 182	39.5°
.684 149	.349 283	.056 623	.492 143	39.6°
.684 242	.349 368	.056 761	.492 104	39.7°
.684 335	.349 453	.056 899	.492 065	39.8°
.684 428	.349 538	.057 037	.492 025	39.9°
0.684 522	0.349 624	0.057 175	0.491 986	40.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C / L	Y / L	X / L
40.0°	13° 16′ 40″	0.978 506	0.952 349	0.224 734
40.1°	13° 18′ 38″	.978 399	.952 116	.225 256
40.2°	13° 20′ 37″	.978 292	.951 882	.225 778
40.3°	13° 22′ 35″	.978 185	.951 648	.226 300
40.4°	13° 24′ 33″	.978 077	.951 413	.226 822
40.5°	13° 26′ 32″	.977 969	.951 178	.227 343
40.6°	13° 28′ 30″	.977 861	.950 942	.227 864
40.7°	13° 30′ 29″	.977 753	.950 706	.228 385
40.8°	13° 32′ 27″	.977 644	.950 469	.228 905
40.9°	13° 34′ 26″	.977 535	.950 231	.229 425
41.0°	13° 36′ 24″	.977 426	.949 993	.229 945
41.1°	13° 38′ 22″	.977 317	.949 755	.230 464
41.2°	13° 40′ 21″	.977 207	.949 516	.230 984
41.3°	13° 42′ 19″	.977 098	.949 277	.231 502
41.4°	13° 44′ 18″	.976 987	.949 037	.332 021
41.5°	13° 46′ 16″	.976 877	.948 796	.232 539
41.6°	13° 48′ 14″	.976 766	.948 555	.233 057
41.7°	13° 50′ 13″	.976 655	.948 314	.233 575
41.8°	13° 52′ 11″	.976 544	.948 072	.234 093
41.9°	13° 54′ 09″	.976 433	.947 829	.234 610
42.0°	13° 56′ 08″	.976 321	.947 586	.235 127
42.1°	13° 58′ 06″	.976 209	.947 342	.235 643
42.2°	14° 00′ 04″	.976 097	.947 098	.236 159
42.3°	14° 02′ 03″	.975 985	.946 853	.236 675
42.4°	14° 04′ 01″	.975 872	.946 608	.237 191
42.5°	14° 05′ 59″	.975 759	.946 362	.237 706
42.6°	14° 07′ 58″	.975 646	.946 116	.238 221
42.7°	14° 09′ 56″	.975 532	.945 869	.238 736
42.8°	14° 11′ 54″	.975 419	.945 622	.239 250
42.9°	14° 13′ 52″	.975 305	.945 374	.239 764
43.0°	14° 15′ 51″	.975 191	.945 126	.240 278
43.1°	14° 17′ 49″	.975 076	.944 877	.240 792
43.2°	14° 19′ 47″	.974 961	.944 628	.241 305
43.3°	14° 21′ 45″	.974 846	.944 378	.241 818
43.4°	14° 23′ 43″	.974 731	.944 128	.242 330
43.5°	14° 25′ 42″	.974 616	.943 877	.242 842
43.6°	14° 27′ 40″	.974 500	.943 625	.243 354
43.7°	14° 29′ 38″	.974 384	.943 373	.243 866
43.8°	14° 31′ 36″	.974 268	.943 121	.244 377
43.9°	14° 33′ 34″	.974 151	.942 868	.244 888
44.0°	14° 35′ 33″	.974 034	.942 614	.245 399
44.1°	14° 37′ 31″	.973 917	.942 360	.245 909
44.2°	14° 39′ 29″	.973 800	.942 106	.246 419
44.3°	14° 41′ 27″	.973 682	.941 851	.246 929
44.4°	14° 43′ 25″	.973 564	.941 595	.247 438
44.5°	14° 45′ 23″	.973 446	.941 339	.247 948
44.6°	14° 47′ 21″	.973 328	.941 083	.248 456
44.7°	14° 49′ 19″	.973 210	.940 826	.248 965
44.8°	14° 51′ 18″	.973 090	.940 568	.249 473
44.9°	14° 53′ 16″	.972 972	.940 310	.249 981
45.0°	14° 55′ 14″	0.972 852	0.940 052	0.250 488

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.684 522	0.349 624	0.057 175	0.491 986	40.0°
.684 615	.349 709	.057 313	.491 946	40.1°
.684 709	.349 796	.057 451	.491 907	40.2°
.684 804	.349 882	.057 589	.491 867	40.3°
.684 898	.349 969	.057 727	.491 827	40.4°
.684 993	.350 056	.057 865	.491 787	40.5°
.685 089	.350 143	.058 003	.491 747	40.6°
.685 184	.350 230	.058 140	.491 707	40.7°
.685 280	.350 318	.058 278	.491 667	40.8°
.685 376	.350 406	.058 416	.491 626	40.9°
.685 472	.350 494	.058 553	.491 586	41.0°
.685 569	.350 583	.058 691	.491 546	41.1°
.685 666	.350 671	.058 828	.491 505	41.2°
.685 763	.350 760	.058 966	.491 464	41.3°
.685 860	.350 850	.059 103	.491 423	41.4°
.685 958	.350 939	.059 241	.491 382	41.5°
.686 056	.351 029	.059 378	.491 342	41.6°
.686 155	.351 119	.059 516	.491 300	41.7°
.686 253	.351 210	.059 653	.493 259	41.8°
.686 352	.351 300	.059 790	.491 218	41.9°
.686 451	.351 391	.059 928	.491 177	42.0°
.686 551	.351 482	.060 065	.491 135	42.1°
.686 651	.351 574	.060 202	.491 094	42.2°
.686 751	.351 665	.060 339	.491 052	42.3°
.686 851	.351 757	.060 476	.491 010	42.4°
.686 952	.351 850	.060 613	.490 969	42.5°
.687 053	.351 942	.060 750	.490 927	42.6°
.687 154	.352 035	.060 887	.490 885	42.7°
.687 255	.352 128	.061 024	.490 843	42.8°
.687 357	.352 221	.061 161	.490 800	42.9°
.687 459	.352 315	.061 298	.490 758	43.0°
.687 562	.352 409	.061 435	.490 716	43.1°
.687 664	.352 503	.061 571	.490 673	43.2°
.687 767	.352 597	.061 708	.490 631	43.3°
.687 871	.352 692	.061 845	.490 588	43.4°
.687 974	.352 787	.061 982	.490 546	43.5°
.688 078	.352 882	.062 118	.490 503	43.6°
.688 182	.352 977	.062 255	.490 460	43.7°
.688 287	.353 073	.062 391	.490 417	43.8°
.688 392	.353 169	.062 528	.490 374	43.9°
.688 497	.353 266	.062 664	.490 330	44.0°
.688 602	.353 362	.062 801	.490 287	44.1°
.688 708	.353 459	.062 937	.490 244	44.2°
.688 813	.353 556	.063 073	.490 200	44.3°
.688 920	.353 654	.063 210	.490 157	44.4°
.689 026	.353 751	.063 346	.490 113	44.5°
.689 133	.353 849	.063 482	.490 069	44.6°
.689 240	.353 948	.063 618	.490 026	44.7°
.689 348	.354 046	.063 754	.489 982	44.8°
.689 455	.354 145	.063 891	.489 938	44.9°
0.689 563	0.354 244	0.064 027	0.489 894	45.0°

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	$\frac{C}{L}$	$\frac{Y}{L}$	$\frac{X}{L}$
45.0°	14° 55′ 14″	0.972 852	0.940 052	0.250 488
45.1°	14° 57′ 12″	.972 733	.939 793	.250 996
45.2°	14° 59′ 10″	.972 613	.939 533	.251 502
45.3°	15° 01′ 08″	.972 493	.939 273	.252 009
45.4°	15° 03′ 06″	.972 372	.939 012	.252 515
45.5°	15° 05′ 04″	.972 252	.938 751	.253 021
45.6°	15° 07′ 02″	.972 131	.938 490	.253 527
45.7°	15° 09′ 00″	.972 010	.938 227	.254 032
45.8°	15° 10′ 58″	.971 888	.937 965	.254 537
45.9°	15° 12′ 56″	.971 767	.937 702	.255 041
46.0°	15° 14′ 54″	.971 645	.937 438	.255 546
46.1°	15° 16′ 52″	.971 523	.937 174	.256 050
46.2°	15° 18′ 50″	.971 400	.936 909	.256 553
46.3°	15° 20′ 48″	.971 278	.936 644	.257 057
46.4°	15° 22′ 46″	.971 155	.936 378	.257 560
46.5°	15° 24′ 44″	.971 032	.936 112	.258 062
46.6°	15° 26′ 42″	.970 908	.935 846	.258 565
46.7°	15° 28′ 40″	.970 785	.935 579	.259 067
46.8°	15° 30′ 38″	.970 661	.935 311	.259 568
46.9°	15° 32′ 35″	.970 537	.935 043	.260 070
47.0°	15° 34′ 33″	.970 412	.934 774	.260 571
47.1°	15° 36′ 31″	.970 287	.934 505	.261 071
47.2°	15° 38′ 29″	.970 162	.934 235	.261 572
47.3°	15° 40′ 27″	.970 037	.933 965	.262 072
47.4°	15° 42′ 25″	.969 912	.933 694	.262 571
47.5°	15° 44′ 23″	.969 786	.933 423	.263 071
47.6°	15° 46′ 21″	.969 660	.933 151	.263 570
47.7°	15° 48′ 18″	.969 534	.932 879	.264 068
47.8°	15° 50′ 16″	.969 408	.932 607	.264 567
47.9°	15° 52′ 14″	.969 281	.932 334	.265 065
48.0°	15° 54′ 12″	.969 154	.932 060	.265 562
48.1°	15° 56′ 10″	.969 027	.931 786	.266 060
48.2°	15° 58′ 07″	.968 899	.931 511	.266 556
48.3°	16° 00′ 05″	.968 771	.931 236	.267 053
48.4°	16° 02′ 03″	.968 644	.930 961	.267 549
48.5°	16° 04′ 01″	.968 515	.930 684	.268 045
48.6°	16° 05′ 58″	.968 387	.930 408	.268 541
48.7°	16° 07′ 56″	.968 258	.930 131	.269 036
48.8°	16° 09′ 54″	.968 129	.929 853	.269 531
48.9°	16° 11′ 52″	.968 000	.929 575	.270 026
49.0°	16° 13′ 49″	.967 870	.929 296	.270 520
49.1°	16° 15′ 47″	.967 741	.929 017	.271 014
49.2°	16° 17′ 45″	.967 611	.928 738	.271 507
49.3°	16° 19′ 42″	.967 480	.928 458	.272 001
49.4°	16° 21′ 40″	.967 350	.928 177	.272 494
49.5°	16° 23′ 38″	.967 219	.927 896	.272 986
49.6°	16° 25′ 35″	.967 088	.927 615	.273 478
49.7°	16° 27′ 33″	.966 957	.927 333	.273 970
49.8°	16° 29′ 31″	.966 825	.927 050	.274 462
49.9°	16° 31′ 28″	.966 694	.926 767	.274 953
50.0°	16° 33′ 26″	0.966 562	0.926 484	0.275 443

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

$\frac{U}{L}$	$\frac{V}{L}$	$\frac{p}{L}$	$\frac{q}{L}$	S
0.689 563	0.354 244	0.064 027	0.489 894	45.0°
.689 672	.354 343	.064 163	.489 849	45.1°
.689 780	.354 443	.064 299	.489 805	45.2°
.689 889	.354 543	.064 435	.489 761	45.3°
.689 999	.354 643	.064 571	.489 716	45.4°
.690 108	.354 744	.064 706	.489 672	45.5°
.690 218	.354 844	.064 842	.489 627	45.6°
.690 328	.354 946	.064 978	.489 582	45.7°
.690 439	.355 047	.065 114	.489 537	45.8°
.690 549	.355 148	.065 249	.489 492	45.9°
.690 660	.355 250	.065 385	.489 447	46.0°
.690 772	.355 353	.065 521	.489 402	46.1°
.690 884	.355 455	.065 656	.489 357	46.2°
.690 996	.355 558	.065 792	.489 312	46.3°
.691 108	.355 661	.065 927	.489 266	46.4°
.691 220	.355 764	.066 063	.489 221	46.5°
.691 333	.355 868	.066 198	.489 175	46.6°
.691 446	.355 972	.066 333	.489 130	46.7°
.691 560	.356 076	.066 469	.489 084	46.8°
.691 674	.356 180	.066 604	.489 038	46.9°
.691 788	.356 285	.066 739	.488 992	47.0°
.691 902	.356 390	.066 874	.488 946	47.1°
.692 017	.356 496	.067 010	.488 900	47.2°
.692 132	.356 601	.067 145	.488 854	47.3°
.692 248	.356 707	.067 280	.488 808	47.4°
.692 364	.356 814	.067 415	.488 761	47.5°
.692 480	.356 920	.067 550	.488 715	47.6°
.692 596	.357 027	.067 684	.488 668	47.7°
.692 712	.357 134	.067 819	.488 622	47.8°
.692 829	.357 242	.067 954	.488 575	47.9°
.692 947	.357 349	.068 089	.488 528	48.0°
.693 064	.357 457	.068 224	.488 481	48.1°
.693 182	.357 566	.068 358	.488 434	48.2°
.693 300	.357 674	.068 493	.488 387	48.3°
.693 419	.357 783	.068 628	.488 340	48.4°
.693 538	.357 892	.068 762	.488 293	48.5°
.693 657	.358 002	.068 897	.488 245	48.6°
.693,777	.358 111	.069 031	.488 198	48.7°
.693 896	.358 222	.069 166	.488 150	48.8°
.694 017	.358 332	.069 300	.488 103	48.9°
.694 137	.358 443	.069 435	.488 055	49.0°
.694 258	.358 554	.069 569	.488 007	49.1°
.694 379	.358 665	.069 703	.487 959	49.2°
.694 500	.358 776	.069 838	.487 911	49.3°
.694 622	.358 888	.069 972	.487 863	49.4°
.694 744	.359 000	.070 106	.487 815	49.5°
.694 867	.359 113	.070 240	.487 767	49.6°
.694 989	.359 226	.070 374	.487 718	49.7°
.695 112	.359 339	.070 508	.487 670	49.8°
.695 236	.359 452	.070 642	.487 621	49.9°
0.695 359	0.359 566	0.070 776	0.487 573	50.0°

TABLE V

Functions of spirals for varying degrees of curve between 30 minutes and 50 degrees for various values of "a".

Select value of $a \left(= \frac{D}{L}\right)$ to correspond with value of "a" shown in table. Values of corresponding functions are then directly obtainable from the table.

Tables for the following values of "a" are given:

a = 0.1	a = 1.25	a = 5.5
a = 0.2	a = 1⅓	a = 6.0
a = 0.25	a = 1.5	a = 6.5
a = 0.3	a = 1.75	a = 7.0
a = 0.4	a = 2.0	a = 8.0
a = 0.5	a = 2.5	a = 9.0
a = 0.6	a = 3.0	a = 10.0
a = 0.7	a = 3.5	a = 12.5
a = 0.8	a = 4.0	a = 15.0
a = 0.9	a = 4.5	a = 20.0
a = 1.0	a = 5.0	a = 25.0

THE STANDARD HIGHWAY SPIRAL

$a = 0.1$

L	D	S	q	p	Y	X	C	U	V
25	0° 01.5′	0° 00.2′	12.50	0.00	25.00	0.00	25.00	16.67	8.33
50	0° 03.0′	0° 00.8′	25.00	0.00	50.00	0.00	50.00	33.33	16.67
75	0° 04.5′	0° 01.7′	37.50	0.00	75.00	0.01	75.00	50.00	25.00
100	0° 06.0′	0° 03.0′	50.00	0.01	100.00	0.03	100.00	66.67	33.33
125	0° 07.5′	0° 04.7′	62.50	0.01	125.00	0.06	125.00	83.33	41.67
150	0° 09.0′	0° 06.8′	75.00	0.02	150.00	0.10	150.00	100.00	50.00
175	0° 10.5′	0° 09.2′	87.50	0.04	175.00	0.16	175.00	116.67	58.33
200	0° 12.0′	0° 12.0′	100.00	0.06	200.00	0.23	200.00	133.33	66.67
225	0° 13.5′	0° 15.2′	112.50	0.08	225.00	0.33	225.00	150.00	75.00
250	0° 15.0′	0° 18.8′	125.00	0.11	250.00	0.45	250.00	166.67	83.33
275	0° 16.5′	0° 22.7′	137.50	0.15	275.00	0.60	275.00	183.33	91.67
300	0° 18.0′	0° 27.0′	150.00	0.20	300.00	0.79	300.00	200.00	100.00
325	0° 19.5′	0° 31.7′	162.50	0.25	325.00	1.00	325.00	216.67	108.33
350	0° 21.0′	0° 36.8′	175.00	0.31	350.00	1.25	350.00	233.33	116.67
375	0° 22.5′	0° 42.2′	187.50	0.38	374.99	1.53	375.00	250.00	125.00
400	0° 24.0′	0° 48.0′	200.00	0.47	399.99	1.86	400.00	266.67	133.34
425	0° 25.5′	0° 54.2′	212.50	0.56	424.99	2.23	425.00	283.34	141.67
450	0° 27.0′	1° 00.8′	225.00	0.66	449.99	2.65	449.99	300.00	150.00
475	0° 28.5′	1° 07.7′	237.50	0.78	474.98	3.12	474.99	316.67	158.34
500	0° 30.0′	1° 15.0′	250.00	0.91	499.98	3.64	499.99	333.34	166.67
525	0° 31.5′	1° 22.7′	262.49	1.05	524.97	4.21	524.99	350.01	175.01
550	0° 33.0′	1° 30.8′	274.99	1.21	549.96	4.84	549.98	366.66	183.35
575	0° 34.5′	1° 39.2′	287.49	1.38	574.95	5.53	574.98	383.35	191.68
600	0° 36.0′	1° 48.0′	299.99	1.57	599.94	6.28	599.97	400.02	200.02
625	0° 37.5′	1° 57.2′	312.49	1.78	624.93	7.10	624.97	416.69	208.36
650	0° 39.0′	2° 06.8′	324.99	2.00	649.91	7.99	649.96	433.36	216.69
675	0° 40.5′	2° 16.7′	337.48	2.24	674.89	8.95	674.95	450.04	225.03
700	0° 42.0′	2° 27.0′	349.98	2.49	699.87	9.98	699.94	466.71	233.37
725	0° 43.5′	2° 37.7′	362.47	2.77	724.85	11.08	724.93	483.39	241.72
750	0° 45.0′	2° 48.8′	374.97	3.07	749.82	12.27	749.92	500.06	250.06
775	0° 46.5′	3° 00.2′	387.46	3.38	774.79	13.54	774.91	516.74	258.40
800	0° 48.0′	3° 12.0′	399.96	3.72	799.75	14.89	799.89	533.42	266.75
825	0° 49.5′	3° 24.2′	412.45	4.08	824.71	16.33	824.87	550.10	275.09
850	0° 51.0′	3° 36.8′	424.94	4.47	849.66	17.86	849.85	566.78	283.44
875	0° 52.5′	3° 49.7′	437.43	4.87	874.61	19.48	874.83	583.47	291.79
900	0° 54.0′	4° 03.0′	449.93	5.30	899.55	21.20	899.80	600.16	300.14
925	0° 55.5′	4° 16.7′	462.41	5.75	924.48	23.01	924.77	616.85	308.50
950	0° 57.0′	4° 30.8′	474.90	6.23	949.41	24.93	949.74	633.54	316.85
975	0° 58.5′	4° 45.2′	487.39	6.74	974.33	26.95	974.70	650.23	325.21
1000	1° 00.0′	5° 00.0′	499.87	7.27	999.24	29.07	999.66	666.93	333.58

THE STANDARD HIGHWAY SPIRAL

$a = 0.2$

L	D	S	q	p	Y	X	C	U	V
25	0° 03′	0° 00.4′	12.50	0.00	25.00	0.00	25.00	16.67	8.33
50	0° 06′	0° 01.5′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
75	0° 09′	0° 03.4′	37.50	0.01	75.00	0.02	75.00	50.00	25.00
100	0° 12′	0° 06.0′	50.00	0.01	100.00	0.06	100.00	66.67	33.33
125	0° 15′	0° 09.4′	62.50	0.03	125.00	0.11	125.00	83.33	41.67
150	0° 18′	0° 13.5′	75.00	0.05	150.00	0.20	150.00	100.00	50.00
175	0° 21′	0° 18.4′	87.50	0.08	175.00	0.31	175.00	116.67	58.33
200	0° 24′	0° 24.0′	100.00	0.12	200.00	0.47	200.00	133.33	66.67
225	0° 27′	0° 30.4′	112.50	0.17	225.00	0.66	225.00	150.00	75.00
250	0° 30′	0° 37.5′	125.00	0.23	250.00	0.91	250.00	166.67	83.33
275	0° 33′	0° 45.4′	137.50	0.30	275.00	1.21	275.00	183.34	91.67
300	0° 36′	0° 54.0′	150.00	0.39	299.99	1.57	300.00	200.00	100.00
325	0° 39′	1° 03.4′	162.50	0.50	324.99	2.00	325.00	216.67	108.34
350	0° 42′	1° 13.5′	175.00	0.62	349.98	2.49	349.99	233.34	116.67
375	0° 45′	1° 24.4′	187.50	0.77	374.98	3.07	374.99	250.01	125.01
400	0° 48′	1° 36.0′	199.99	0.93	399.97	3.72	399.99	266.68	133.34
425	0° 51′	1° 48.4′	212.49	1.12	424.96	4.47	424.98	283.35	141.68
450	0° 54′	2° 01.5′	224.99	1.33	449.94	5.30	449.98	300.02	150.02
475	0° 57′	2° 15.4′	237.49	1.56	474.93	6.23	474.97	316.69	158.36
500	1° 00′	2° 30.0′	249.98	1.82	499.90	7.27	499.96	333.37	166.70
525	1° 03′	2° 45.4′	262.48	2.10	524.88	8.42	524.95	350.04	175.04
550	1° 06′	3° 01.5′	274.97	2.42	549.85	9.68	549.93	366.72	183.38
575	1° 09′	3° 18.4′	287.47	2.76	574.81	11.06	574.91	383.40	191.73
600	1° 12′	3° 36.0′	299.96	3.14	599.76	12.56	599.89	400.08	200.08
625	1° 15′	3° 54.4′	312.45	3.55	624.71	14.20	624.87	416.77	208.43
650	1° 18′	4° 13.5′	324.94	3.99	649.65	15.97	649.84	433.46	216.78
675	1° 21′	4° 33.4′	337.43	4.47	674.57	17.88	674.81	450.15	225.14
700	1° 24′	4° 54.0′	349.91	4.99	699.49	19.94	699.77	466.85	233.50
725	1° 27′	5° 15.4′	362.40	5.54	724.39	22.16	724.73	483.55	241.86
750	1° 30′	5° 37.5′	374.88	6.13	749.28	24.53	749.68	500.25	250.23
775	1° 33′	6° 00.4′	387.36	6.77	774.15	27.06	774.62	516.96	258.60
800	1° 36′	6° 24.0′	399.83	7.44	799.00	29.76	799.56	533.68	266.98
825	1° 39′	6° 48.4′	412.31	8.17	823.84	32.63	824.48	550.41	275.37
850	1° 42′	7° 13.5′	424.77	8.93	848.65	35.69	849.40	567.14	283.76
875	1° 45′	7° 39.4′	437.24	9.74	873.44	38.92	874.31	583.88	292.16
900	1° 48′	8° 06.0′	449.70	10.60	898.20	42.35	899.20	600.63	300.57
925	1° 51′	8° 33.4′	462.16	11.50	922.94	45.97	924.08	617.39	308.99
950	1° 54′	9° 01.5′	474.61	12.46	947.65	49.79	948.95	634.16	317.42
975	1° 57′	9° 30.4′	487.05	13.47	972.32	53.82	973.81	650.94	325.85
1000	2° 00′	10° 00.0′	499.49	14.53	996.96	58.05	998.65	667.73	334.30

THE STANDARD HIGHWAY SPIRAL

a = 0.25

L	D	S	q	p	Y	X	C	U	V
20	0° 03′	0° 00.3′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
40	0° 06′	0° 01.2′	20.00	0.00	40.00	0.00	40.00	26.67	13.33
60	0° 09′	0° 02.7′	30.00	0.00	60.00	0.02	60.00	40.00	20.00
80	0° 12′	0° 04.8′	40.00	0.01	80.00	0.04	80.00	53.33	26.67
100	0° 15′	0° 07.5′	50.00	0.02	100.00	0.07	100.00	66.67	33.33
120	0° 18′	0° 10.8′	60.00	0.03	120.00	0.13	120.00	80.00	40.00
140	0° 21′	0° 14.7′	70.00	0.05	140.00	0.20	140.00	93.33	46.67
160	0° 24′	0° 19.2′	80.00	0.07	160.00	0.30	160.00	106.67	53.33
180	0° 27′	0° 24.3′	90.00	0.11	180.00	0.42	180.00	120.00	60.00
200	0° 30′	0° 30.0′	100.00	0.15	200.00	0.58	200.00	133.33	66.67
220	0° 33′	0° 36.3′	110.00	0.19	220.00	0.77	220.00	146.67	73.33
240	0° 36′	0° 43.2′	120.00	0.25	240.00	1.01	240.00	160.00	80.00
260	0° 39′	0° 50.7′	130.00	0.32	259.99	1.28	260.00	173.34	86.67
280	0° 42′	0° 58.8′	140.00	0.40	279.99	1.60	280.00	186.67	93.34
300	0° 45′	1° 07.5′	150.00	0.49	299.99	1.96	299.99	200.00	100.00
320	0° 48′	1° 16.8′	160.00	0.60	319.98	2.38	319.99	213.34	106.67
340	0° 51′	1° 26.7′	170.00	0.71	339.98	2.86	339.99	226.67	113.34
360	0° 54′	1° 37.2′	180.00	0.85	359.97	3.39	359.99	240.01	120.01
380	0° 57′	1° 48.3′	189.99	1.00	379.96	3.99	379.98	253.35	126.68
400	1° 00′	2° 00.0′	199.99	1.16	399.95	4.65	399.95	266.68	133.25
420	1° 03′	2° 12.3′	209.99	1.35	419.94	5.39	419.97	280.02	140.02
440	1° 06′	2° 25.2′	219.99	1.55	439.92	6.19	439.97	293.36	146.69
460	1° 09′	2° 38.7′	229.98	1.77	459.90	7.08	459.96	306.70	153.36
480	1° 12′	2° 52.8′	239.98	2.01	479.88	8.04	479.95	320.04	160.04
500	1° 15′	3° 07.5′	249.98	2.27	499.85	9.09	499.93	333.39	166.71
520	1° 18′	3° 22.8′	259.97	2.56	519.82	10.22	519.92	346.73	173.39
540	1° 21′	3° 38.7′	269.96	2.86	539.78	11.45	539.90	360.08	180.07
560	1° 24′	3° 55.2′	279.96	3.19	559.74	12.77	559.88	373.42	186.75
580	1° 27′	4° 12.3′	289.95	3.55	579.69	14.18	579.86	386.78	193.43
600	1° 30′	4° 30.0′	299.94	3.93	599.63	15.70	599.84	400.13	200.12
620	1° 33′	4° 48.3′	309.93	4.33	619.56	17.32	619.81	413.49	206.81
640	1° 36′	5° 07.2′	319.91	4.76	639.49	19.05	639.77	426.85	213.50
660	1° 39′	5° 26.7′	329.90	5.23	659.40	20.89	659.74	440.21	220.19
680	1° 42′	5° 46.8′	339.88	5.71	679.31	22.85	679.69	453.58	226.89
700	1° 45′	6° 07.5′	349.87	6.23	699.20	24.92	699.64	466.95	233.59
720	1° 48′	6° 28.8′	359.85	6.78	719.08	27.12	719.59	480.32	240.29
740	1° 51′	6° 50.7′	369.82	7.36	738.94	29.44	739.53	493.70	247.00
760	1° 54′	7° 13.2′	379.80	7.98	758.79	31.89	759.46	507.09	253.72
780	1° 57′	7° 36.3′	389.77	8.62	778.63	34.47	779.39	520.48	260.44
800	2° 00′	8° 00.0′	399.74	9.30	798.44	37.18	799.31	533.88	267.16
820	2° 03′	8° 24.3′	409.71	10.02	818.24	40.04	819.22	547.28	273.89
840	2° 06′	8° 49.2′	419.67	10.77	838.01	43.03	839.12	560.70	280.63
860	2° 09′	9° 14.7′	429.63	11.55	857.76	46.17	859.01	574.12	287.38
880	2° 12′	9° 40.8′	439.58	12.38	877.49	49.46	878.88	587.55	294.13
900	2° 15′	10° 07.5′	449.53	13.24	897.19	52.90	898.75	600.98	300.90
920	2° 18′	10° 34.8′	459.48	14.14	916.87	56.49	918.61	614.43	307.67
940	2° 21′	11° 02.7′	469.42	15.08	936.51	60.24	938.45	627.89	314.45
960	2° 24′	11° 31.2′	479.35	16.06	956.13	64.15	958.28	641.36	321.24
980	2° 27′	12° 00.3′	489.28	17.08	975.71	68.23	978.09	654.84	328.04
1000	2° 30′	12° 30.0′	499.21	18.15	995.25	72.48	997.89	668.34	334.85

THE STANDARD HIGHWAY SPIRAL

a = 0.3

L	D	S	q	p	Y	X	C	U	V
25	0° 04.5′	0° 00.6′	12.50	0.00	25.00	0.00	25.00	16.67	8.33
50	0° 09.0′	0° 02.3′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
75	0° 13.5′	0° 05.1′	37.50	0.01	75.00	0.04	75.00	50.00	25.00
100	0° 18.0′	0° 09.0′	50.00	0.02	100.00	0.09	100.00	66.67	33.33
125	0° 22.5′	0° 14.1′	62.50	0.04	125.00	0.17	125.00	83.33	41.67
150	0° 27.0′	0° 20.3′	75.00	0.07	150.00	0.29	150.00	100.00	50.00
175	0° 31.5′	0° 27.6′	87.50	0.12	175.00	0.47	175.00	116.67	58.33
200	0° 36.0′	0° 36.0′	100.00	0.17	200.00	0.70	200.00	133.33	66.67
225	0° 40.5′	0° 45.6′	112.50	0.25	225.00	0.99	225.00	150.00	75.00
250	0° 45.0′	0° 56.3′	125.00	0.34	249.99	1.36	250.00	166.67	83.34
275	0° 49.5′	1° 08.1′	137.50	0.45	274.99	1.81	275.00	183.34	91.67
300	0° 54.0′	1° 21.0′	150.00	0.59	299.98	2.36	299.99	200.01	100.01
325	0° 58.5′	1° 35.1′	162.50	0.75	324.98	3.00	324.99	216.68	108.34
350	1° 03.0′	1° 50.3′	174.99	0.94	349.96	3.74	349.98	233.35	116.68
375	1° 07.5′	2° 06.6′	187.49	1.15	374.95	4.60	374.98	250.02	125.02
400	1° 12.0′	2° 24.0′	199.99	1.40	399.93	5.58	399.97	266.69	133.36
425	1° 16.5′	2° 42.6′	212.48	1.67	424.90	6.70	424.96	283.37	141.70
450	1° 21.0′	3° 02.3′	224.98	1.99	449.87	7.95	449.94	300.04	150.04
475	1° 25.5′	3° 23.1′	237.47	2.34	474.83	9.35	474.93	316.72	158.39
500	1° 30.0′	3° 45.0′	249.96	2.73	499.79	10.90	499.90	333.41	166.73
525	1° 34.5′	4° 08.1′	262.45	3.16	524.73	12.62	524.88	350.10	175.09
550	1° 39.0′	4° 32.3′	274.94	3.63	549.66	14.51	549.85	366.79	183.44
575	1° 43.5′	4° 57.6′	287.42	4.15	574.57	16.58	574.81	383.48	191.80
600	1° 48.0′	5° 24.0′	299.91	4.71	599.47	18.84	599.76	400.19	200.17
625	1° 52.5′	5° 51.6′	312.39	5.32	624.35	21.29	624.71	416.90	208.54
650	1° 57.0′	6° 20.3′	324.87	5.99	649.21	23.94	649.65	433.61	216.92
675	2° 01.5′	6° 50.1′	337.34	6.71	674.04	26.81	674.57	450.34	225.31
700	2° 06.0′	7° 21.0′	349.81	7.48	698.85	29.90	699.49	467.07	233.70
725	2° 10.5′	7° 53.1′	362.27	8.31	723.63	33.21	724.39	483.81	242.10
750	2° 15.0′	8° 26.3′	374.73	9.20	748.38	36.76	749.28	500.57	250.52
775	2° 19.5′	9° 00.6′	387.18	10.15	773.09	40.55	774.15	517.34	258.94
800	2° 24.0′	9° 36.0′	399.63	11.16	797.76	44.59	799.00	534.12	267.38
825	2° 28.5′	10° 12.6′	412.06	12.24	822.38	48.89	823.84	550.92	275.83
850	2° 33.0′	10° 50.3′	424.49	13.38	846.96	53.46	848.65	567.73	284.30
875	2° 37.5′	11° 29.1′	436.91	14.59	871.49	58.29	873.44	584.57	292.79
900	2° 42.0′	12° 09.0′	449.33	15.88	895.96	63.41	898.20	601.42	301.29
925	2° 46.5′	12° 50.1′	461.73	17.24	920.37	68.82	922.94	618.30	309.81
950	2° 51.0′	13° 32.3′	474.12	18.67	944.71	74.52	947.65	635.20	318.36
975	2° 55.5′	14° 15.6′	486.50	20.18	968.98	80.53	972.32	652.12	326.93
1000	3° 00.0′	15° 00.0′	498.86	21.76	993.17	86.84	996.96	669.08	335.52

THE STANDARD HIGHWAY SPIRAL

a = 0.4

L	D	S	q	p	Y	X	C	U	V
25	0° 06′	0° 00.8′	12.50	0.00	25.00	0.00	25.00	16.67	8.33
50	0° 12′	0° 03.0′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
75	0° 18′	0° 06.8′	37.50	0.01	75.00	0.05	75.00	50.00	25.00
100	0° 24′	0° 12.0′	50.00	0.03	100.00	0.12	100.00	66.67	33.33
125	0° 30′	0° 18.8′	62.50	0.06	125.00	0.23	125.00	83.33	41.67
150	0° 36′	0° 27.0′	75.00	0.10	150.00	0.39	150.00	100.00	50.00
175	0° 42′	0° 36.8′	87.50	0.16	175.00	0.62	175.00	116.67	58.33
200	0° 48′	0° 48.0′	100.00	0.23	200.00	0.93	200.00	133.33	66.67
225	0° 54′	1° 00.8′	112.50	0.33	224.99	1.33	225.00	150.00	75.00
250	1° 00′	1° 15.0′	125.00	0.45	249.99	1.82	249.99	166.67	83.34
275	1° 06′	1° 30.8′	137.50	0.60	274.98	2.42	274.99	183.34	91.67
300	1° 12′	1° 48.0′	150.00	0.79	299.97	3.14	299.99	200.01	100.01
325	1° 18′	2° 06.8′	162.49	1.00	324.96	3.99	324.98	216.68	108.35
350	1° 24′	2° 27.0′	174.99	1.25	349.94	4.99	349.97	233.36	116.69
375	1° 30′	2° 48.8′	187.48	1.53	374.91	6.13	374.96	250.03	125.03
400	1° 36′	3° 12.0′	199.98	1.86	399.88	7.45	399.94	266.71	133.37
425	1° 42′	3° 36.8′	212.47	2.22	424.83	8.93	424.92	283.39	141.72
450	1° 48′	4° 03.0′	224.96	2.65	449.78	10.60	449.90	300.08	150.07
475	1° 54′	4° 30.8′	237.45	3.12	474.71	12.46	474.87	316.77	158.43
500	2° 00′	5° 00.0′	249.94	3.64	499.62	14.54	499.83	333.47	166.79
525	2° 06′	5° 30.8′	262.42	4.21	524.51	16.83	524.78	350.17	175.15
550	2° 12′	6° 03.0′	274.90	4.84	549.39	19.34	549.73	366.88	183.53
575	2° 18′	6° 36.8′	287.37	5.53	574.23	22.10	574.66	383.60	191.91
600	2° 24′	7° 12.0′	299.84	6.28	599.05	25.10	599.58	400.33	200.30
625	2° 30′	7° 48.8′	312.31	7.10	623.84	28.37	624.48	417.07	208.70
650	2° 36′	8° 27.0′	324.76	7.98	648.59	31.90	649.37	433.83	217.12
675	2° 42′	9° 06.8′	337.22	8.94	673.29	35.72	674.24	450.60	225.54
700	2° 48′	9° 48.0′	349.66	9.97	697.95	39.83	699.09	467.38	233.99
725	2° 54′	10° 30.8′	362.09	11.07	722.56	44.23	723.92	484.19	242.44
750	3° 00′	11° 15.0′	374.52	12.26	747.11	48.95	748.72	501.01	250.92
775	3° 06′	12° 00.8′	386.93	13.52	771.60	53.99	773.49	517.86	259.42
800	3° 12′	12° 48.0′	399.34	14.87	796.02	59.36	798.23	534.73	267.94
825	3° 18′	13° 36.8′	411.73	16.30	820.36	65.07	822.93	551.64	276.49
850	3° 24′	14° 27.0′	424.10	17.82	844.61	71.13	847.60	568.57	285.06
875	3° 30′	15° 18.8′	436.46	19.44	868.77	77.55	872.23	585.53	293.67
900	3° 36′	16° 12.0′	448.80	21.15	892.83	84.34	896.81	602.53	302.30
925	3° 42′	17° 06.8′	461.13	22.95	916.78	91.50	921.34	619.57	310.98
950	3° 48′	18° 03.0′	473.43	24.85	940.61	99.06	945.82	636.66	319.69
975	3° 54′	19° 00.8′	485.72	26.86	964.32	107.00	970.24	653.79	328.45
1000	4° 00′	20° 00.0′	497.98	28.96	987.88	115.35	994.60	670.97	337.25

THE STANDARD HIGHWAY SPIRAL

a = 0.5

L	D	S	q	p	Y	X	C	U	V
20	0° 06′	0° 00.6′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
40	0° 12′	0° 02.4′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
60	0° 18′	0° 05.4′	30.00	0.01	60.00	0.03	60.00	40.00	20.00
80	0° 24′	0° 09.6′	40.00	0.02	80.00	0.07	80.00	53.33	26.67
100	0° 30′	0° 15.0′	50.00	0.04	100.00	0.15	100.00	66.67	33.33
120	0° 36′	0° 21.6′	60.00	0.06	120.00	0.25	120.00	80.00	40.00
140	0° 42′	0° 29.4′	70.00	0.10	140.00	0.40	140.00	93.33	46.67
160	0° 48′	0° 38.4′	80.00	0.15	160.00	0.60	160.00	106.67	53.33
180	0° 54′	0° 48.6′	90.00	0.21	180.00	0.85	180.00	120.00	60.00
200	1° 00′	1° 00.0′	100.00	0.29	199.99	1.16	200.00	133.34	66.67
220	1° 06′	1° 12.6′	110.00	0.39	219.99	1.55	220.00	146.67	73.34
240	1° 12′	1° 26.4′	120.00	0.50	239.98	2.01	239.99	160.01	80.00
260	1° 18′	1° 41.4′	130.00	0.64	259.98	2.56	259.99	173.34	86.67
280	1° 24′	1° 57.6′	139.99	0.80	279.97	3.19	279.99	186.68	93.34
300	1° 30′	2° 15.0′	149.99	0.98	299.95	3.93	299.98	200.02	100.01
320	1° 36′	2° 33.6′	159.99	1.19	319.94	4.77	319.97	213.36	106.69
340	1° 42′	2° 53.4′	169.99	1.43	339.91	5.72	339.96	226.70	113.36
360	1° 48′	3° 14.4′	179.98	1.70	359.88	6.78	359.95	240.04	120.04
380	1° 54′	3° 36.6′	189.97	1.99	379.85	7.98	379.93	253.39	126.71
400	2° 00′	4° 00.0′	199.97	2.33	399.81	9.31	399.91	266.73	133.40
420	2° 06′	4° 24.6′	209.96	2.69	419.75	10.77	419.89	280.09	140.08
440	2° 12′	4° 50.4′	219.95	3.10	439.69	12.38	439.86	293.44	146.77
460	2° 18′	5° 17.4′	229.93	3.54	459.61	14.15	459.83	306.80	153.46
480	2° 24′	5° 45.6′	239.92	4.02	479.52	16.07	479.78	320.17	160.15
500	2° 30′	6° 15.0′	249.90	4.54	499.41	18.17	499.74	333.54	166.86
520	2° 36′	6° 45.6′	259.88	5.11	519.28	20.43	519.68	346.92	173.56
540	2° 42′	7° 17.4′	269.85	5.72	539.13	22.88	539.61	360.31	180.28
560	2° 48′	7° 50.4′	279.83	6.38	558.95	25.51	559.53	373.70	187.00
580	2° 54′	8° 24.6′	289.79	7.09	578.75	28.33	579.44	387.10	193.73
600	3° 00′	9° 00.0′	299.75	7.85	598.52	31.36	599.34	400.52	200.47
620	3° 06′	9° 36.6′	309.71	8.66	618.26	34.59	619.23	413.94	207.22
640	3° 12′	10° 14.4′	319.66	9.52	637.96	38.04	639.09	427.38	213.98
660	3° 18′	10° 53.4′	329.60	10.44	657.62	41.71	658.94	440.84	220.76
680	3° 24′	11° 33.6′	339.54	11.42	677.24	45.60	678.77	454.30	227.55
700	3° 30′	12° 15.0′	349.47	12.45	696.81	49.72	698.58	467.79	234.35
720	3° 36′	12° 57.6′	359.39	13.55	716.32	54.09	718.36	481.29	241.18
740	3° 42′	13° 41.4′	369.30	14.70	735.79	58.70	738.12	494.82	248.02
760	3° 48′	14° 26.4′	379.20	15.93	755.19	63.56	757.86	508.36	254.88
780	3° 54′	15° 12.6′	389.09	17.21	774.52	68.67	777.56	521.93	261.76
800	4° 00′	16° 00.0′	398.96	18.57	793.78	74.05	797.23	535.53	268.66
820	4° 06′	16° 48.6′	408.83	19.99	812.97	79.70	816.87	549.15	275.59
840	4° 12′	17° 38.4′	418.68	21.48	832.07	85.62	836.47	562.81	282.55
860	4° 18′	18° 29.4′	428.51	23.04	851.09	91.82	856.03	576.49	289.54
880	4° 24′	19° 21.6′	438.33	24.68	870.01	98.31	875.54	590.21	296.56
900	4° 30′	20° 15.0′	448.13	26.39	888.82	105.08	895.01	603.97	303.62
920	4° 36′	21° 09.6′	457.92	28.18	907.53	112.16	914.44	617.77	310.71
940	4° 42′	22° 05.4′	467.68	30.04	926.12	119.53	933.80	631.62	317.84
960	4° 48′	23° 02.4′	477.42	31.98	944.59	127.20	953.12	645.51	325.01
980	4° 54′	24° 00.6′	487.15	34.01	962.93	135.18	972.37	659.45	332.23
1000	5° 00′	25° 00.0′	496.84	36.11	981.13	143.48	991.56	673.44	339.50

THE STANDARD HIGHWAY SPIRAL

$a = 0.6$

L	D	S	q	p	Y	X	C	U	V
10	0° 03.6′	0° 00.2′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 07.2′	0° 00.7′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 10.8′	0° 01.6′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0° 14.4′	0° 02.9′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0° 18.0′	0° 04.5′	25.00	0.01	50.00	0.02	50.00	33.33	16.67
60	0° 21.6′	0° 06.5′	30.00	0.01	60.00	0.04	60.00	40.00	20.00
70	0° 25.2′	0° 08.8′	35.00	0.01	70.00	0.06	70.00	46.67	23.33
80	0° 28.8′	0° 11.5′	40.00	0.02	80.00	0.09	80.00	53.33	26.67
90	0° 32.4′	0° 14.6′	45.00	0.03	90.00	0.13	90.00	60.00	30.00
100	0° 36.0′	0° 18.0′	50.00	0.04	100.00	0.17	100.00	66.67	33.33
110	0° 39.6′	0° 21.8′	55.00	0.06	110.00	0.23	110.00	73.33	36.67
120	0° 43.2′	0° 25.9′	60.00	0.08	120.00	0.30	120.00	80.00	40.00
130	0° 46.8′	0° 30.4′	65.00	0.10	130.00	0.38	130.00	86.67	43.33
140	0° 50.4′	0° 35.3′	70.00	0.12	140.00	0.48	140.00	93.33	46.67
150	0° 54.0′	0° 40.5′	75.00	0.15	150.00	0.59	150.00	100.00	50.00
160	0° 57.6′	0° 46.1′	80.00	0.18	160.00	0.71	160.00	106.67	53.33
170	1° 01.2′	0° 52.0′	85.00	0.21	170.00	0.86	170.00	113.33	56.67
180	1° 04.8′	0° 58.3′	90.00	0.25	179.99	1.02	180.00	120.00	60.00
190	1° 08.4′	1° 05.0′	95.00	0.30	189.99	1.20	190.00	126.67	63.34
200	1° 12.0′	1° 12.0′	100.00	0.35	199.99	1.40	200.00	133.34	66.67
210	1° 15.6′	1° 19.4′	105.00	0.40	209.99	1.62	210.00	140.00	70.00
220	1° 19.2′	1° 27.1′	110.00	0.46	219.99	1.86	219.99	146.67	73.34
230	1° 22.8′	1° 35.2′	115.00	0.53	229.98	2.12	229.99	153.34	76.67
240	1° 26.4′	1° 43.7′	120.00	0.60	239.98	2.41	239.99	160.01	80.01
250	1° 30.0′	1° 52.5′	125.00	0.68	249.97	2.73	249.99	166.68	83.34
260	1° 33.6′	2° 01.7′	129.99	0.77	259.97	3.07	259.99	173.34	86.68
270	1° 37.2′	2° 11.2′	134.99	0.86	269.96	3.43	269.98	180.01	90.01
280	1° 40.8′	2° 21.1′	139.99	0.96	279.95	3.83	279.98	186.68	93.35
290	1° 44.4′	2° 31.4′	144.99	1.06	289.94	4.26	289.98	193.35	96.68
300	1° 48.0′	2° 42.0′	149.99	1.18	299.93	4.71	299.97	200.02	100.02
310	1° 51.6′	2° 53.0′	154.99	1.30	309.92	5.20	309.97	206.69	103.36
320	1° 55.2′	3° 04.3′	159.98	1.43	319.91	5.72	319.96	213.37	106.70
330	1° 58.8′	3° 16.0′	164.98	1.57	329.89	6.27	329.95	220.04	110.03
340	2° 02.4′	3° 28.1′	169.98	1.71	339.88	6.86	339.94	226.71	113.37
350	2° 06.0′	3° 40.5′	174.98	1.87	349.86	7.48	349.94	233.38	116.71
360	2° 09.6′	3° 53.3′	179.97	2.04	359.83	8.14	359.93	240.06	120.05
370	2° 13.2′	4° 06.4′	184.97	2.21	369.81	8.84	369.92	246.73	123.39
380	2° 16.8′	4° 19.9′	189.96	2.39	379.78	9.57	379.90	253.41	126.74
390	2° 20.4′	4° 33.8′	194.96	2.59	389.75	10.35	389.89	260.09	130.08
400	2° 24.0′	4° 48.0′	199.95	2.79	399.72	11.16	399.88	266.76	133.42
410	2° 27.6′	5° 02.6′	204.95	3.01	409.68	12.02	409.86	273.44	136.77
420	2° 31.2′	5° 17.5′	209.94	3.23	419.64	12.92	419.84	280.13	140.11
430	2° 34.8′	5° 32.8′	214.93	3.47	429.60	13.87	429.82	286.81	143.46
440	2° 38.4′	5° 48.5′	219.92	3.72	439.55	14.86	439.80	293.49	146.81
450	2° 42.0′	6° 04.5′	224.92	3.97	449.49	15.89	449.78	300.18	150.16
460	2° 45.6′	6° 20.9′	229.91	4.25	459.44	16.97	459.75	306.86	153.51
470	2° 49.2′	6° 37.6′	234.90	4.53	469.37	18.10	469.72	313.55	156.87
480	2° 52.8′	6° 54.7′	239.88	4.82	479.30	19.28	479.69	320.24	160.22
490	2° 56.4′	7° 12.2′	244.87	5.13	489.23	20.51	489.66	326.94	163.58
500	3° 00.0′	7° 30.0′	249.86	5.45	499.14	21.79	499.62	333.63	166.94

THE STANDARD HIGHWAY SPIRAL

a = 0.6—Continued

L	D	S	q	p	Y	X	C	U	V
510	3° 03.6′	7° 48.2′	254.84	5.78	509.05	23.12	509.58	340.33	170.30
520	3° 07.2′	8° 06.7′	259.83	6.13	518.96	24.51	519.54	347.03	173.66
530	3° 10.8′	8° 25.6′	264.81	6.49	528.85	25.94	529.49	353.73	177.03
540	3° 14.4′	8° 44.9′	269.79	6.86	538.74	27.44	539.44	360.44	180.40
550	3° 18.0′	9° 04.5′	274.77	7.25	548.62	28.99	549.39	367.15	183.77
560	3° 21.6′	9° 24.5′	279.75	7.66	558.49	30.59	559.33	373.86	187.15
570	3° 25.2′	9° 44.8′	284.73	8.07	568.35	32.26	569.27	380.58	190.53
580	3° 28.8′	10° 05.5′	289.70	8.50	578.20	33.98	579.20	387.30	193.91
590	3° 32.4′	10° 26.6′	294.67	8.95	588.04	35.76	589.13	394.02	197.29
600	3° 36.0′	10° 48.0′	299.65	9.41	597.87	37.60	599.05	400.75	200.68
610	3° 39.6′	11° 09.8′	304.61	9.89	607.69	39.51	608.97	407.48	204.07
620	3° 43.2′	11° 31.9′	309.58	10.38	617.49	41.48	618.88	414.21	207.47
630	3° 46.8′	11° 54.4′	314.55	10.89	627.28	43.51	628.79	420.95	210.87
640	3° 50.4′	12° 17.3′	319.51	11.42	637.06	45.60	638.69	427.70	214.27
650	3° 54.0′	12° 40.5′	324.47	11.96	646.83	47.76	648.59	434.45	217.68
660	3° 57.6′	13° 04.1′	329.43	12.52	656.57	49.99	658.48	441.20	221.10
670	4° 01.2′	13° 28.0′	334.38	13.10	666.31	52.29	668.36	447.97	224.52
680	4° 04.8′	13° 52.3′	339.34	13.69	676.02	54.65	678.23	454.73	227.94
690	4° 08.4′	14° 17.0′	344.29	14.30	685.72	57.08	688.10	461.51	231.37
700	4° 12.0′	14° 42.0′	349.23	14.93	695.41	59.58	697.95	468.29	234.81
710	4° 15.6′	15° 07.4′	354.18	15.58	705.07	62.16	707.80	475.07	238.25
720	4° 19.2′	15° 33.1′	359.12	16.24	714.71	64.80	717.65	481.87	241.70
730	4° 22.8′	15° 59.2′	364.05	16.93	724.34	67.52	727.48	488.67	245.15
740	4° 26.4′	16° 25.7′	368.99	17.63	733.94	70.31	737.30	495.47	248.61
750	4° 30.0′	16° 52.5′	373.92	18.35	743.52	73.18	747.11	502.29	252.08
760	4° 33.6′	17° 19.7′	378.84	19.09	753.08	76.12	756.92	509.12	255.56
770	4° 37.2′	17° 47.2′	383.77	19.85	762.61	79.13	766.71	515.95	259.05
780	4° 40.8′	18° 15.1′	388.68	20.63	772.12	82.23	776.49	522.79	262.54
790	4° 44.4′	18° 43.4′	393.60	21.43	781.61	85.40	786.26	529.64	266.04
800	4° 48.0′	19° 12.0′	398.51	22.25	791.06	88.65	796.01	536.50	269.55
810	4° 51.6′	19° 41.0′	403.41	23.09	800.49	91.98	805.76	543.38	273.07
820	4° 55.2′	20° 10.3′	408.31	23.95	809.89	95.38	815.49	550.26	276.60
830	4° 58.8′	20° 40.0′	413.21	24.83	819.27	98.87	825.21	557.15	280.14
840	5° 02.4′	21° 10.1′	418.10	25.74	828.61	102.44	834.92	564.06	283.69
850	5° 06.0′	21° 40.5′	422.98	26.66	837.92	106.09	844.61	570.97	287.25
860	5° 09.6′	22° 11.3′	427.86	27.60	847.19	109.83	854.28	577.90	290.83
870	5° 13.2′	22° 42.4′	432.73	28.57	856.43	113.65	863.94	584.84	294.41
880	5° 16.8′	23° 13.9′	437.60	29.56	865.64	117.55	873.59	591.80	298.01
890	5° 20.4′	23° 45.8′	442.46	30.57	874.81	121.54	883.21	598.77	301.61
900	5° 24.0′	24° 18.0′	447.32	31.61	883.95	125.61	892.83	605.75	305.24
910	5° 27.6′	24° 50.6′	452.16	32.66	893.04	129.77	902.42	612.75	308.87
920	5° 31.2′	25° 23.5′	457.00	33.74	902.09	134.01	911.99	619.76	312.52
930	5° 34.8′	25° 56.8′	461.84	34.84	911.11	138.34	921.55	626.79	316.19
940	5° 38.4′	26° 30.5′	466.67	35.97	920.08	142.76	931.09	633.84	319.86
950	5° 42.0′	27° 04.5′	471.49	37.11	929.00	147.27	940.61	640.90	323.56
960	5° 45.6′	27° 38.9′	476.30	38.28	937.89	151.87	950.10	647.98	327.27
970	5° 49.2′	28° 13.6′	481.10	39.48	946.72	156.55	959.58	655.08	331.00
980	5° 52.8′	28° 48.7′	485.90	40.70	955.51	161.33	969.03	662.20	334.74
990	5° 56.4′	29° 24.2′	490.69	41.94	964.24	166.19	978.46	669.34	338.51
1000	6° 00.0′	30° 00.0′	495.47	43.21	972.93	171.14	987.87	676.50	342.29

THE STANDARD HIGHWAY SPIRAL

$a = 0.7$

L	D	S	q	p	Y	X	C	U	V
10	0° 04.2′	0° 00.2′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 08.4′	0° 00.8′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 12.6′	0° 01.9′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 16.8′	0° 03.4′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0° 21.0′	0° 05.3′	25.00	0.01	50.00	0.03	50.00	33.33	16.67
60	0° 25.2′	0° 07.6′	30.00	0.01	60.00	0.04	60.00	40.00	20.00
70	0° 29.4′	0° 10.3′	35.00	0.02	70.00	0.07	70.00	46.67	23.33
80	0° 33.6′	0° 13.4′	40.00	0.03	80.00	0.10	80.00	53.33	26.67
90	0° 37.8′	0° 17.0′	45.00	0.04	90.00	0.15	90.00	60.00	30.00
100	0° 42.0′	0° 21.0′	50.00	0.05	100.00	0.20	100.00	66.67	33.33
110	0° 46.2′	0° 25.4′	55.00	0.07	110.00	0.27	110.00	73.33	36.67
120	0° 50.4′	0° 30.2′	60.00	0.09	120.00	0.35	120.00	80.00	40.00
130	0° 54.6′	0° 35.5′	65.00	0.11	130.00	0.45	130.00	86.67	43.33
140	0° 58.8′	0° 41.2′	70.00	0.14	140.00	0.56	140.00	93.33	46.67
150	1° 03.0′	0° 47.3′	75.00	0.17	150.00	0.69	150.00	100.00	50.00
160	1° 07.2′	0° 53.8′	80.00	0.21	160.00	0.83	160.00	106.67	53.33
170	1° 11.4′	1° 00.7′	85.00	0.25	169.99	1.00	170.00	113.34	56.67
180	1° 15.6′	1° 08.0′	90.00	0.30	179.99	1.19	180.00	120.00	60.00
190	1° 19.8′	1° 15.8′	95.00	0.35	189.99	1.40	190.00	126.67	63.34
200	1° 24.0′	1° 24.0′	100.00	0.41	199.99	1.63	199.99	133.34	66.67
210	1° 28.2′	1° 32.6′	105.00	0.47	209.98	1.89	209.99	140.01	70.00
220	1° 32.4′	1° 41.6′	110.00	0.54	219.98	2.17	219.99	146.67	73.34
230	1° 36.6′	1° 51.1′	115.00	0.62	229.98	2.48	229.99	153.34	76.67
240	1° 40.8′	2° 01.0′	120.00	0.70	239.97	2.81	239.99	160.01	80.01
250	1° 45.0′	2° 11.3′	124.99	0.80	249.96	3.18	249.98	166.63	83.34
260	1° 49.2′	2° 22.0′	129.99	0.89	259.96	3.58	259.98	173.35	86.68
270	1° 53.4′	2° 33.1′	134.99	1.00	269.95	4.01	269.98	180.02	90.02
280	1° 57.6′	2° 44.6′	139.99	1.12	279.94	4.47	279.97	186.69	93.35
290	2° 01.8′	2° 56.6′	144.99	1.24	289.92	4.97	289.97	193.36	96.69
300	2° 06.0′	3° 09.0′	149.98	1.37	299.91	5.50	299.96	200.03	100.03
310	2° 10.2′	3° 21.8′	154.98	1.52	309.89	6.06	309.95	206.70	103.37
320	2° 14.4′	3° 35.0′	159.98	1.67	319.87	6.67	319.94	213.38	106.71
330	2° 18.6′	3° 48.7′	164.98	1.83	329.85	7.32	329.94	220.05	110.05
340	2° 22.8′	4° 02.8′	169.97	2.00	339.83	8.00	339.92	226.73	113.39
350	2° 27.0′	4° 17.3′	174.97	2.18	349.80	8.73	349.91	233.40	116.73
360	2° 31.2′	4° 32.2′	179.96	2.37	359.77	9.50	359.90	240.08	120.07
370	2° 35.4′	4° 47.5′	184.96	2.58	369.74	10.31	369.88	246.76	123.42
380	2° 39.6′	5° 03.2′	189.95	2.79	379.70	11.17	379.87	253.44	126.76
390	2° 43.8′	5° 19.4′	194.94	3.02	389.66	12.07	389.85	260.12	130.11
400	2° 48.0′	5° 36.0′	199.94	3.26	399.62	13.02	399.83	266.80	133.45
410	2° 52.2′	5° 53.0′	204.93	3.50	409.57	14.02	409.81	273.48	136.80
420	2° 56.4′	6° 10.4′	209.92	3.77	419.51	15.07	419.78	280.17	140.15
430	3° 00.6′	6° 28.3′	214.91	4.05	429.45	16.17	429.76	286.86	143.51
440	3° 04.8′	6° 46.6′	219.90	4.33	439.38	17.33	439.73	293.55	146.86
450	3° 09.0′	7° 05.3′	224.89	4.64	449.31	18.53	449.69	300.24	150.22
460	3° 13.2′	7° 24.4′	229.87	4.95	459.23	19.80	459.66	306.94	153.58
470	3° 17.4′	7° 43.9′	234.86	5.28	469.14	21.11	469.62	313.63	156.94
480	3° 21.6′	8° 03.8′	239.84	5.63	479.05	22.49	479.58	320.33	160.30
490	3° 25.8′	8° 24.2′	244.82	5.98	488.95	23.92	489.53	327.04	163.67
500	3° 30.0′	8° 45.0′	249.81	6.36	498.84	25.41	499.48	333.74	167.04

THE STANDARD HIGHWAY SPIRAL

a = 0.7—Continued

L	D	S	q	p	Y	X	C	U	V
510	3° 34.2′	9° 06.2′	254.79	6.75	508.71	26.96	509.43	340.45	170.41
520	3° 38.4′	9° 27.8′	259.76	7.15	518.58	28.58	519.37	347.16	173.78
530	3° 42.6′	9° 49.9′	264.74	7.57	528.44	30.25	529.31	353.88	177.16
540	3° 46.8′	10° 12.4′	269.71	8.01	538.29	31.99	539.24	360.60	180.55
550	3° 51.0′	10° 35.3′	274.69	8.46	548.12	33.80	549.17	367.32	183.93
560	3° 55.2′	10° 58.6′	279.66	8.93	557.95	35.67	559.09	374.05	187.32
570	3° 59.4′	11° 22.3′	284.63	9.41	567.76	37.60	569.00	380.79	190.72
580	4° 03.6′	11° 46.4′	289.59	9.92	577.56	39.61	578.91	387.53	194.11
590	4° 07.8′	12° 11.0′	294.56	10.44	587.34	41.68	588.82	394.27	197.52
600	4° 12.0′	12° 36.0′	299.52	10.98	597.10	43.83	598.71	401.02	200.93
610	4° 16.2′	13° 01.4′	304.48	11.53	606.86	46.05	608.60	407.77	204.34
620	4° 20.4′	13° 27.2′	309.43	12.11	616.59	48.34	618.48	414.53	207.76
630	4° 24.6′	13° 53.5′	314.38	12.70	626.31	50.70	628.36	421.30	211.18
640	4° 28.8′	14° 20.2′	319.33	13.31	636.00	53.14	638.22	428.07	214.61
650	4° 33.0′	14° 47.3′	324.28	13.95	645.68	55.65	648.08	434.86	218.05
660	4° 37.2′	15° 14.8′	329.22	14.60	655.34	58.25	657.93	441.64	221.49
670	4° 41.4′	15° 42.7′	334.16	15.27	664.98	60.91	667.76	448.44	224.95
680	4° 45.6′	16° 11.0′	339.10	15.96	674.59	63.66	677.59	455.24	228.40
690	4° 49.8′	16° 39.8′	344.03	16.67	684.19	66.49	687.41	462.05	231.87
700	4° 54.0′	17° 09.0′	348.96	17.40	693.75	69.40	697.22	468.88	235.34
710	4° 58.2′	17° 38.6′	353.88	18.16	703.30	72.39	707.01	475.71	238.83
720	5° 02.4′	18° 08.6′	358.80	18.93	712.81	75.46	716.80	482.55	242.32
730	5° 06.6′	18° 39.1′	363.71	19.73	722.30	78.61	726.57	489.40	245.82
740	5° 10.8′	19° 10.0′	368.62	20.55	731.76	81.86	736.33	496.26	249.33
750	5° 15.0′	19° 41.3′	373.52	21.39	741.19	85.18	746.07	503.13	252.85
760	5° 19.2′	20° 13.0′	378.43	22.25	750.59	88.59	755.80	510.01	256.38
770	5° 23.4′	20° 45.1′	383.32	23.13	759.96	92.09	765.52	516.91	259.92
780	5° 27.6′	21° 17.6′	388.21	24.04	769.29	95.68	775.22	523.81	263.47
790	5° 31.8′	21° 50.6′	393.09	24.97	778.59	99.36	784.91	530.73	267.03
800	5° 36.0′	22° 24.0′	397.97	25.92	787.86	103.12	794.58	537.67	270.61
810	5° 40.2′	22° 57.8′	402.84	26.90	797.09	106.98	804.23	544.61	274.20
820	5° 44.4′	23° 32.0′	407.71	27.90	806.27	110.92	813.87	551.58	277.80
830	5° 48.6′	24° 06.7′	412.56	28.92	815.42	114.96	823.49	558.55	281.42
840	5° 52.8′	24° 41.8′	417.41	29.97	824.53	119.10	833.08	565.55	285.05
850	5° 57.0′	25° 17.3′	422.26	31.05	833.59	123.32	842.66	572.56	288.70
860	6° 01.2′	25° 53.2′	427.09	32.14	842.61	127.64	852.22	579.59	292.36
870	6° 05.4′	26° 29.5′	431.92	33.27	851.58	132.05	861.76	586.63	296.04
880	6° 09.6′	27° 06.2′	436.74	34.41	860.51	136.56	871.28	593.69	299.73
890	6° 13.8′	27° 43.4′	441.55	35.59	869.39	141.16	880.77	600.78	303.45
900	6° 18.0′	28° 21.0′	446.35	36.79	878.21	145.86	890.24	607.88	307.18
910	6° 22.2′	28° 59.0′	451.15	38.01	886.99	150.66	899.69	615.00	310.93
920	6° 26.4′	29° 37.4′	455.93	39.26	895.71	155.56	909.12	622.15	314.70
930	6° 30.6′	30° 16.3′	460.71	40.54	904.37	160.55	918.51	629.31	318.49
940	6° 34.8′	30° 55.6′	465.47	41.84	912.98	165.64	927.88	636.50	322.30
950	6° 39.0′	31° 35.3′	470.23	43.17	921.53	170.83	937.23	643.72	326.13
960	6° 43.2′	32° 15.4′	474.97	44.53	930.02	176.11	946.55	650.96	329.99
970	6° 47.4′	32° 55.9′	479.71	45.92	938.44	181.50	955.83	658.22	333.86
980	6° 51.6′	33° 36.8′	484.43	47.33	946.80	186.99	965.09	665.51	337.77
990	6° 55.8′	34° 18.2′	489.14	48.77	955.10	192.57	974.32	672.83	341.70
1000	7° 00.0′	35° 00.0′	493.84	50.23	963.32	198.26	983.51	680.18	345.65

THE STANDARD HIGHWAY SPIRAL

$a = 0.8$

L	D	S	q	p	Y	X	C	U	V
10	0° 04.8′	0° 00.2′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 09.6′	0° 01.0′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 14.4′	0° 02.2′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 19.2′	0° 03.8′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0° 24.0′	0° 06.0′	25.00	0.01	50.00	0.03	50.00	33.33	16.67
60	0° 28.8′	0° 08.6′	30.00	0.01	60.00	0.05	60.00	40.00	20.00
70	0° 33.6′	0° 11.8′	35.00	0.02	70.00	0.08	70.00	46.67	23.33
80	0° 38.4′	0° 15.4′	40.00	0.03	80.00	0.12	80.00	53.33	26.67
90	0° 43.2′	0° 19.4′	45.00	0.04	90.00	0.17	90.00	60.00	30.00
100	0° 48.0′	0° 24.0′	50.00	0.06	100.00	0.23	100.00	66.67	33.33
110	0° 52.8′	0° 29.0′	55.00	0.08	110.00	0.31	110.00	73.33	36.67
120	0° 57.6′	0° 34.6′	60.00	0.10	120.00	0.40	120.00	80.00	40.00
130	1° 02.4′	0° 40.6′	65.00	0.13	130.00	0.51	130.00	86.67	43.33
140	1° 07.2′	0° 47.0′	70.00	0.16	140.00	0.64	140.00	93.33	46.67
150	1° 12.0′	0° 54.0′	75.00	0.20	150.00	0.79	150.00	100.00	50.00
160	1° 16.8′	1° 01.4′	80.00	0.24	159.99	0.95	160.00	106.67	53.33
170	1° 21.6′	1° 09.4′	85.00	0.29	169.99	1.14	170.00	113.34	56.67
180	1° 26.4′	1° 17.8′	90.00	0.34	179.99	1.36	180.00	120.00	60.00
190	1° 31.2′	1° 26.6′	95.00	0.40	189.99	1.60	189.99	126.67	63.34
200	1° 36.0′	1° 36.0′	100.00	0.47	199.98	1.86	199.99	133.34	66.67
210	1° 40.8′	1° 45.8′	105.00	0.54	209.98	2.15	209.99	140.01	70.01
220	1° 45.6′	1° 56.2′	110.00	0.62	219.97	2.47	219.99	146.68	73.34
230	1° 50.4′	2° 07.0′	114.99	0.71	229.97	2.83	229.99	153.34	76.68
240	1° 55.2′	2° 18.2′	119.99	0.80	239.96	3.22	239.98	160.01	80.01
250	2° 00.0′	2° 30.0′	124.99	0.91	249.95	3.64	249.98	166.68	83.35
260	2° 04.8′	2° 42.2′	129.99	1.02	259.94	4.09	259.97	173.35	86.69
270	2° 09.6′	2° 55.0′	134.99	1.14	269.93	4.58	269.97	180.02	90.02
280	2° 14.4′	3° 08.2′	139.99	1.28	279.92	5.11	279.96	186.70	93.36
290	2° 19.2′	3° 21.8′	144.98	1.42	289.90	5.67	289.96	193.37	96.70
300	2° 24.0′	3° 36.0′	149.98	1.57	299.88	6.28	299.95	200.04	100.04
310	2° 28.8′	3° 50.6′	154.98	1.73	309.86	6.93	309.94	206.72	103.38
320	2° 33.6′	4° 05.8′	159.97	1.91	319.84	7.62	319.93	213.39	106.72
330	2° 38.4′	4° 21.4′	164.97	2.09	329.81	8.36	329.92	220.07	110.06
340	2° 43.2′	4° 37.4′	169.96	2.29	339.78	9.14	339.90	226.74	113.40
350	2° 48.0′	4° 54.0′	174.96	2.49	349.74	9.97	349.89	233.42	116.75
360	2° 52.8′	5° 11.0′	179.95	2.71	359.71	10.85	359.87	240.10	120.09
370	2° 57.6′	5° 28.6′	184.94	2.95	369.66	11.78	369.85	246.79	123.44
380	3° 02.4′	5° 46.6′	189.94	3.19	379.61	12.76	379.83	253.47	126.79
390	3° 07.2′	6° 05.0′	194.93	3.45	389.56	13.79	389.80	260.15	130.14
400	3° 12.0′	6° 24.0′	199.92	3.72	399.50	14.88	399.78	266.84	133.49
410	3° 16.8′	6° 43.4′	204.91	4.01	409.44	16.02	409.75	273.53	136.85
420	3° 21.6′	7° 03.4′	209.89	4.31	419.36	17.22	419.72	280.22	140.20
430	3° 26.4′	7° 23.8′	214.88	4.62	429.28	18.48	429.68	286.92	143.56
440	3° 31.2′	7° 44.6′	219.87	4.95	439.20	19.80	439.64	293.61	146.92
450	3° 36.0′	8° 06.0′	224.85	5.30	449.10	21.18	449.60	300.31	150.29
460	3° 40.8′	8° 27.8′	229.83	5.66	459.00	22.62	459.55	307.02	153.65
470	3° 45.6′	8° 50.2′	234.81	6.04	468.88	24.12	469.50	313.72	157.02
480	3° 50.4′	9° 13.0′	239.79	6.43	478.76	25.69	479.45	320.43	160.40
490	3° 55.2′	9° 36.2′	244.77	6.84	488.63	27.32	489.39	327.15	163.77
500	4° 00.0′	10° 00.0′	249.75	7.26	498.48	29.03	498.32	333.87	167.15

THE STANDARD HIGHWAY SPIRAL

a = 0.8—Continued

L	D	S	q	p	Y	X	C	U	V
510	4° 04.8′	10° 24.2′	254.72	7.71	508.32	30.80	509.25	340.59	170.54
520	4° 09.6′	10° 49.0′	259.69	8.17	518.15	32.64	519.18	347.32	173.92
530	4° 14.4′	11° 14.2′	264.66	8.65	527.97	34.55	529.09	354.05	177.32
540	4° 19.2′	11° 39.8′	269.63	9.15	537.77	36.54	539.01	360.78	180.71
550	4° 24.0′	12° 06.0′	274.59	9.66	547.55	38.59	548.91	367.53	184.12
560	4° 28.8′	12° 32.6′	279.55	10.20	557.32	40.73	558.81	374.28	187.52
570	4° 33.6′	12° 59.8′	284.51	10.75	567.07	42.94	568.70	381.03	190.94
580	4° 38.4′	13° 27.4′	289.47	11.33	576.81	45.23	578.58	387.79	194.35
590	4° 43.2′	13° 55.4′	294.42	11.92	586.53	47.59	588.45	394.56	197.78
600	4° 48.0′	14° 24.0′	299.37	12.54	596.22	50.04	598.32	401.33	201.21
610	4° 52.8′	14° 53.0′	304.32	13.17	605.90	52.57	608.17	408.11	204.65
620	4° 57.6′	15° 22.6′	309.26	13.83	615.55	55.18	618.02	414.90	208.09
630	5° 02.4′	15° 52.6′	314.20	14.51	625.18	57.87	627.85	421.70	211.55
640	5° 07.2′	16° 23.0′	319.13	15.21	634.79	60.65	637.68	428.51	215.01
650	5° 12.0′	16° 54.0′	324.06	15.93	644.37	63.51	647.49	435.32	218.48
660	5° 16.8′	17° 25.4′	328.99	16.67	653.92	66.46	657.29	442.15	221.96
670	5° 21.6′	17° 57.4′	333.91	17.44	663.45	69.50	667.08	448.99	225.44
680	5° 26.4′	18° 29.8′	338.82	18.22	672.95	72.63	676.86	455.83	228.94
690	5° 31.2′	19° 02.6′	343.73	19.04	682.42	75.85	686.62	462.69	232.45
700	5° 36.0′	19° 36.0′	348.64	19.87	691.85	79.16	696.37	469.56	235.97
710	5° 40.8′	20° 09.8′	353.54	20.73	701.26	82.56	706.10	476.44	239.49
720	5° 45.6′	20° 44.2′	358.43	21.61	710.63	86.05	715.82	483.34	243.03
730	5° 50.4′	21° 19.0′	363.32	22.52	719.96	89.64	725.52	490.24	246.59
740	5° 55.2′	21° 54.2′	368.20	23.45	729.26	93.32	735.20	497.16	250.15
750	6° 00.0′	22° 30.0′	373.08	24.41	738.52	97.10	744.87	504.10	253.73
760	6° 04.8′	23° 06.2′	377.95	25.39	747.73	100.97	754.52	511.05	257.32
770	6° 09.6′	23° 43.0′	382.81	26.40	756.91	104.95	764.15	518.02	260.93
780	6° 14.4′	24° 20.2′	387.67	27.43	766.05	109.02	773.76	525.00	264.55
790	6° 19.2′	24° 57.8′	392.51	28.49	775.13	113.19	783.35	532.00	268.19
800	6° 24.0′	25° 36.0′	397.35	29.58	784.18	117.46	792.92	539.02	271.84
810	6° 28.8′	26° 14.6′	402.18	30.69	793.17	121.83	802.47	546.06	275.51
820	6° 33.6′	26° 53.8′	407.01	31.83	802.11	126.30	812.00	553.11	279.20
830	6° 38.4′	27° 33.4′	411.82	32.99	811.01	130.88	821.50	560.19	282.91
840	6° 43.2′	28° 13.4′	416.63	34.18	819.84	135.56	830.98	567.29	286.64
850	6° 48.0′	28° 54.0′	421.42	35.41	828.63	140.34	840.43	574.41	290.38
860	6° 52.8′	29° 35.0′	426.21	36.65	837.35	145.22	849.85	581.55	294.15
870	6° 57.6′	30° 16.6′	430.98	37.93	846.02	150.21	859.25	588.72	297.94
880	7° 02.4′	30° 58.6′	435.75	39.24	854.62	155.31	868.62	595.91	301.75
890	7° 07.2′	31° 41.0′	440.50	40.57	863.17	160.51	877.96	603.12	305.59
900	7° 12.0′	32° 24.0′	445.25	41.93	871.64	165.81	887.27	610.37	309.45
910	7° 16.8′	33° 07.4′	449.98	43.32	880.05	171.22	896.55	617.64	313.33
920	7° 21.6′	33° 51.4′	454.70	44.74	888.39	176.74	905.80	624.94	317.24
930	7° 26.4′	34° 35.8′	459.41	46.19	896.66	182.36	915.02	632.27	321.18
940	7° 31.2′	35° 20.6′	464.10	47.67	904.85	188.10	924.20	639.63	325.15
950	7° 36.0′	36° 06.0′	468.78	49.18	912.97	193.93	933.34	647.02	329.15
960	7° 40.8′	36° 51.8′	473.45	50.72	921.01	199.88	942.45	654.45	333.18
970	7° 45.6′	37° 38.2′	478.11	52.29	928.97	205.93	951.53	661.91	337.24
980	7° 50.4′	38° 25.0′	482.75	53.89	936.85	212.09	960.56	669.41	341.33
990	7° 55.2′	39° 12.2′	487.37	55.52	944.64	218.36	969.55	676.95	345.46
1000	8° 00.0′	40° 00.0′	491.99	57.18	952.35	224.73	978.51	684.52	349.62

THE STANDARD HIGHWAY SPIRAL

a = 0.9

L	D	S	q	p	Y	X	C	U	V
10	0° 05.4′	0° 00.3′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 10.8′	0° 01.1′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 16.2′	0° 02.4′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 21.6′	0° 04.3′	20.00	0.00	40.00	0.02	40.00	26.67	13.33
50	0° 27.0′	0° 06.8′	25.00	0.01	50.00	0.03	50.00	33.33	16.67
60	0° 32.4′	0° 09.7′	30.00	0.01	60.00	0.06	60.00	40.00	20.00
70	0° 37.8′	0° 13.2′	35.00	0.02	70.00	0.09	70.00	46.67	23.33
80	0° 43.2′	0° 17.3′	40.00	0.03	80.00	0.13	80.00	53.33	26.67
90	0° 48.6′	0° 21.9′	45.00	0.05	90.00	0.19	90.00	60.00	30.00
100	0° 54.0′	0° 27.0′	50.00	0.07	100.00	0.26	100.00	66.67	33.33
110	0° 59.4′	0° 32.7′	55.00	0.09	110.00	0.35	110.00	73.33	36.67
120	1° 04.8′	0° 38.9′	60.00	0.11	120.00	0.45	120.00	80.00	40.00
130	1° 10.2′	0° 45.6′	65.00	0.14	130.00	0.58	130.00	86.67	43.33
140	1° 15.6′	0° 52.9′	70.00	0.18	140.00	0.72	140.00	93.33	46.67
150	1° 21.0′	1° 00.8′	75.00	0.22	150.00	0.88	150.00	100.00	50.00
160	1° 26.4′	1° 09.1′	80.00	0.27	159.99	1.07	160.00	106.67	53.34
170	1° 31.8′	1° 18.0′	85.00	0.32	169.99	1.29	170.00	113.34	56.67
180	1° 37.2′	1° 27.5′	90.00	0.38	179.99	1.53	179.99	120.00	60.00
190	1° 42.6′	1° 37.5′	95.00	0.45	189.98	1.80	189.99	126.67	63.34
200	1° 48.0′	1° 48.0′	100.00	0.52	199.98	2.09	199.99	133.34	66.67
210	1° 53.4′	1° 59.1′	105.00	0.61	209.97	2.42	209.99	140.01	70.01
220	1° 58.8′	2° 10.7′	109.99	0.70	219.97	2.79	219.99	146.68	73.34
230	2° 04.2′	2° 22.8′	114.99	0.80	229.96	3.18	229.98	153.35	76.68
240	2° 09.6′	2° 35.5′	119.99	0.91	239.95	3.62	239.98	160.02	80.02
250	2° 15.0′	2° 48.8′	124.99	1.02	249.94	4.09	249.97	166.69	83.35
260	2° 20.4′	3° 02.5′	129.99	1.15	259.93	4.60	259.97	173.36	86.69
270	2° 25.8′	3° 16.8′	134.99	1.29	269.91	5.15	269.96	180.03	90.03
280	2° 31.2′	3° 31.7′	139.98	1.44	279.89	5.75	279.95	186.70	93.37
290	2° 36.6′	3° 47.1′	144.98	1.60	289.87	6.38	289.94	193.38	96.71
300	2° 42.0′	4° 03.0′	149.98	1.77	299.85	7.07	299.93	200.05	100.05
310	2° 47.4′	4° 19.5′	154.97	1.95	309.82	7.80	309.92	206.73	103.39
320	2° 52.8′	4° 36.5′	159.97	2.14	319.79	8.57	319.91	213.41	106.73
330	2° 58.2′	4° 54.0′	164.96	2.35	329.76	9.40	329.89	220.08	110.08
340	3° 03.6′	5° 12.1′	169.95	2.57	339.72	10.28	339.88	226.76	113.42
350	3° 09.0′	5° 30.8′	174.95	2.81	349.68	11.22	349.86	233.45	116.77
360	3° 14.4′	5° 49.9′	179.94	3.05	359.63	12.21	359.83	240.13	120.12
370	3° 19.8′	6° 09.6′	184.93	3.31	369.57	13.25	369.81	246.82	123.47
380	3° 25.2′	6° 29.9′	189.92	3.59	379.51	14.35	379.79	253.50	126.82
390	3° 30.6′	6° 50.7′	194.91	3.88	389.44	15.51	389.75	260.19	130.18
400	3° 36.0′	7° 12.0′	199.89	4.19	399.37	16.74	399.72	266.89	133.53
410	3° 41.4′	7° 33.9′	204.88	4.51	409.29	18.02	409.68	273.58	136.89
420	3° 46.8′	7° 56.3′	209.87	4.85	419.19	19.37	419.64	280.28	140.26
430	3° 52.2′	8° 19.2′	214.85	5.20	429.09	20.78	429.60	286.98	143.62
440	3° 57.6′	8° 42.7′	219.83	5.57	438.98	22.26	439.55	293.69	146.99
450	4° 03.0′	9° 06.8′	224.81	5.96	448.86	23.81	449.49	300.40	150.36
460	4° 08.4′	9° 31.3′	229.79	6.36	458.73	25.43	459.44	307.11	153.74
470	4° 13.8′	9° 56.4′	234.76	6.79	468.59	27.12	469.37	313.83	157.12
480	4° 19.2′	10° 22.1′	239.74	7.23	478.43	28.89	479.30	320.55	160.50
490	4° 24.6′	10° 48.3′	244.71	7.69	488.26	30.72	489.23	327.28	163.89
500	4° 30.0′	11° 15.0′	249.68	8.17	498.08	32.63	499.14	334.01	167.28

THE STANDARD HIGHWAY SPIRAL

a = 0.9—Continued

L	D	S	q	p	Y	X	C	U	V
510	4° 35.4′	11° 42.3′	254.65	8.67	507.88	34.62	509.05	340.75	170.68
520	4° 40.8′	12° 10.1′	259.61	9.19	517.66	36.69	518.96	347.49	174.08
530	4° 46.2′	12° 38.4′	264.57	9.73	527.43	38.84	528.85	354.24	177.49
540	4° 51.6′	13° 07.3′	269.53	10.29	537.17	41.07	538.74	360.99	180.90
550	4° 57.0′	13° 36.8′	274.48	10.87	546.90	43.38	548.62	367.76	184.32
560	5° 02.4′	14° 06.7′	279.43	11.47	556.61	45.78	558.49	374.53	187.75
570	5° 07.8′	14° 37.2′	284.38	12.09	566.30	48.26	568.35	381.30	191.19
580	5° 13.2′	15° 08.3′	289.33	12.74	575.96	50.83	578.20	388.09	194.63
590	5° 18.6′	15° 39.9′	294.27	13.41	585.61	53.48	588.04	394.88	198.08
600	5° 24.0′	16° 12.0′	299.20	14.10	595.22	56.23	597.87	401.69	201.54
610	5° 29.4′	16° 44.7′	304.13	14.81	604.81	59.06	607.69	408.50	205.00
620	5° 34.8′	17° 17.9′	309.06	15.55	614.37	61.99	617.49	415.32	208.48
630	5° 40.2′	17° 51.6′	313.98	16.31	623.91	65.01	627.28	422.16	211.96
640	5° 45.6′	18° 25.9′	318.90	17.09	633.41	68.12	637.06	429.00	215.46
650	5° 51.0′	19° 00.8′	323.81	17.90	642.88	71.33	646.82	435.86	218.96
660	5° 56.4′	19° 36.1′	328.72	18.74	652.32	74.64	656.57	442.73	222.48
670	6° 01.8′	20° 12.0′	333.62	19.60	661.72	78.04	666.31	449.61	226.01
680	6° 07.2′	20° 48.5′	338.51	20.48	671.09	81.55	676.02	456.51	229.55
690	6° 12.6′	21° 25.5′	343.40	21.39	680.41	85.15	685.72	463.41	233.11
700	6° 18.0′	22° 03.0′	348.28	22.33	689.70	88.85	695.40	470.34	236.68
710	6° 23.4′	22° 41.1′	353.15	23.29	698.95	92.66	705.07	477.28	240.26
720	6° 28.8′	23° 19.7′	358.02	24.28	708.16	96.57	714.71	484.24	243.85
730	6° 34.2′	23° 58.8′	362.88	25.30	717.32	100.58	724.33	491.21	247.47
740	6° 39.6′	24° 38.5′	367.73	26.35	726.43	104.69	733.93	498.20	251.10
750	6° 45.0′	25° 18.8′	372.57	27.42	735.49	108.92	743.51	505.21	254.74
760	6° 50.4′	25° 59.5′	377.41	28.52	744.51	113.25	753.07	512.24	258.41
770	6° 55.8′	26° 40.8′	382.23	29.65	753.47	117.68	762.60	519.29	262.09
780	7° 01.2′	27° 22.7′	387.05	30.81	762.38	122.23	772.11	526.36	265.79
790	7° 06.6′	28° 05.1′	391.86	31.99	771.23	126.88	781.60	533.45	269.51
800	7° 12.0′	28° 48.0′	396.65	33.21	780.02	131.64	791.05	540.57	273.25
810	7° 17.4′	29° 31.5′	401.44	34.45	788.75	136.51	800.48	547.71	277.02
820	7° 22.8′	30° 15.5′	406.22	35.73	797.42	141.50	809.88	554.87	280.81
830	7° 28.2′	31° 00.0′	410.98	37.03	806.03	146.59	819.25	562.06	284.62
840	7° 33.6′	31° 45.1′	415.74	38.37	814.57	151.80	828.59	569.28	288.46
850	7° 39.0′	32° 30.8′	420.48	39.74	823.04	157.12	837.90	576.53	292.32
860	7° 44.4′	33° 16.9′	425.21	41.13	831.43	162.55	847.17	583.81	296.21
870	7° 49.8′	34° 03.6′	429.93	42.56	839.75	168.09	856.41	591.11	300.13
880	7° 55.2′	34° 50.9′	434.63	44.02	848.00	173.75	865.62	598.45	304.08
890	8° 00.6′	35° 38.7′	439.32	45.51	856.17	179.52	874.78	605.83	308.06
900	8° 06.0′	36° 27.0′	444.00	47.03	864.25	185.41	883.92	613.23	312.07
910	8° 11.4′	37° 15.9′	448.66	48.58	872.25	191.40	893.01	620.68	316.11
920	8° 16.8′	38° 05.3′	453.31	50.17	880.17	197.52	902.06	628.16	320.19
930	8° 22.2′	38° 55.2′	457.94	51.79	887.99	203.74	911.07	635.68	324.30
940	8° 27.6′	39° 45.7′	462.55	53.44	895.73	210.08	920.03	643.24	328.46
950	8° 33.0′	40° 36.8′	467.15	55.12	903.37	216.53	928.96	650.85	332.65
960	8° 38.4′	41° 28.3′	471.74	56.83	910.91	223.10	937.83	658.49	336.88
970	8° 43.8′	42° 20.4′	476.30	58.58	918.35	229.78	946.66	666.19	341.15
980	8° 49.2′	43° 13.1′	480.85	60.36	925.69	236.57	955.44	673.93	345.47
990	8° 54.6′	44° 06.3′	485.38	62.18	932.93	243.47	964.17	681.72	349.83
1000	9° 00.0′	45° 00.0′	489.89	64.03	940.05	250.49	972.85	689.56	354.24

THE STANDARD HIGHWAY SPIRAL

a = 1.0

L	D	S	q	p	Y	X	C	U	V
10	0° 06′	0° 00.3′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 12′	0° 01.2′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 18′	0° 02.7′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 24′	0° 04.8′	20.00	0.00	40.00	0.02	40.00	26.67	13.33
50	0° 30′	0° 07.5′	25.00	0.01	50.00	0.04	50.00	33.33	16.67
60	0° 36′	0° 10.8′	30.00	0.02	60.00	0.06	60.00	40.00	20.00
70	0° 42′	0° 14.7′	35.00	0.02	70.00	0.10	70.00	46.67	23.33
80	0° 48′	0° 19.2′	40.00	0.04	80.00	0.15	80.00	53.33	26.67
90	0° 54′	0° 24.3′	45.00	0.05	90.00	0.21	90.00	60.00	30.00
100	1° 00′	0° 30.0′	50.00	0.07	100.00	0.29	100.00	66.67	33.33
110	1° 06′	0° 36.3′	55.00	0.10	110.00	0.39	110.00	73.33	36.67
120	1° 12′	0° 43.2′	60.00	0.13	120.00	0.50	120.00	80.00	40.00
130	1° 18′	0° 50.7′	65.00	0.16	130.00	0.64	130.00	86.67	43.33
140	1° 24′	0° 58.8′	70.00	0.20	140.00	0.80	140.00	93.33	46.67
150	1° 30′	1° 07.5′	75.00	0.25	149.99	0.98	150.00	100.00	50.00
160	1° 36′	1° 16.8′	80.00	0.30	159.99	1.19	160.00	106.67	53.34
170	1° 42′	1° 26.7′	85.00	0.36	169.99	1.43	170.00	113.34	56.67
180	1° 48′	1° 37.2′	90.00	0.42	179.99	1.70	179.99	120.01	60.00
190	1° 54′	1° 48.3′	95.00	0.50	189.98	2.00	189.99	126.67	63.34
200	2° 00′	2° 00.0′	100.00	0.58	199.98	2.33	199.99	133.34	66.67
210	2° 06′	2° 12.3′	104.99	0.67	209.97	2.69	209.99	140.01	70.01
220	2° 12′	2° 25.2′	109.99	0.77	219.96	3.10	219.98	146.68	73.35
230	2° 18′	2° 38.7′	114.99	0.88	229.95	3.54	229.98	153.35	76.68
240	2° 24′	2° 52.8′	119.99	1.01	239.94	4.02	239.97	160.02	80.02
250	2° 30′	3° 07.5′	124.99	1.14	249.93	4.54	249.97	166.69	83.36
260	2° 36′	3° 22.8′	129.98	1.28	259.91	5.11	259.96	173.36	86.70
270	2° 42′	3° 38.7′	134.98	1.43	269.89	5.72	269.95	180.04	90.03
280	2° 48′	3° 55.2′	139.98	1.60	279.87	6.38	279.94	186.71	93.37
290	2° 54′	4° 12.3′	144.97	1.77	289.84	7.08	289.93	193.39	96.72
300	3° 00′	4° 30.0′	149.97	1.96	299.81	7.85	299.92	200.06	100.06
310	3° 06′	4° 48.3′	154.96	2.17	309.78	8.66	309.90	206.74	103.40
320	3° 12′	5° 07.2′	159.96	2.38	319.74	9.53	319.89	213.42	106.75
330	3° 18′	5° 26.7′	164.95	2.61	329.70	10.45	329.87	220.10	110.09
340	3° 24′	5° 46.8′	169.94	2.86	339.65	11.42	339.85	226.79	113.44
350	3° 30′	6° 07.5′	174.93	3.12	349.60	12.46	349.82	233.47	116.79
360	3° 36′	6° 28.8′	179.92	3.39	359.54	13.56	359.80	240.16	120.15
370	3° 42′	6° 50.7′	184.91	3.68	369.47	14.72	369.77	246.85	123.50
380	3° 48′	7° 13.2′	189.90	3.99	379.40	15.94	379.73	253.54	126.86
390	3° 54′	7° 36.3′	194.89	4.31	389.31	17.23	389.69	260.24	130.22
400	4° 00′	8° 00.0′	199.87	4.65	399.22	18.59	399.65	266.94	133.58
410	4° 06′	8° 24.3′	204.85	5.01	409.12	20.02	409.61	273.64	136.95
420	4° 12′	8° 49.2′	209.83	5.38	419.01	21.51	419.56	280.35	140.32
430	4° 18′	9° 14.7′	214.81	5.78	428.88	23.08	429.50	287.06	143.69
440	4° 24′	9° 40.8′	219.79	6.19	438.75	24.73	439.44	293.77	147.07
450	4° 30′	10° 07.5′	224.77	6.62	448.60	26.45	449.38	300.49	150.45
460	4° 36′	10° 34.8′	229.74	7.07	458.43	28.25	459.30	307.22	153.83
470	4° 42′	11° 02.7′	234.71	7.54	468.26	30.12	469.22	313.95	157.22
480	4° 48′	11° 31.2′	239.68	8.03	478.06	32.08	479.14	320.68	160.62
490	4° 54′	12° 00.3′	244.64	8.54	487.85	34.12	489.04	327.42	164.02
500	5° 00′	12° 30.0′	249.60	9.07	497.63	36.24	498.94	334.17	167.43

THE STANDARD HIGHWAY SPIRAL

a = 1.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	5° 06′	13° 00.3′	254.56	9.63	507.38	38.44	508.83	340.92	170.84
520	5° 12′	13° 31.2′	259.52	10.21	517.11	40.74	518.71	347.68	174.26
530	5° 18′	14° 02.7′	264.47	10.80	526.82	43.12	528.59	354.45	177.68
540	5° 24′	14° 34.8′	269.42	11.42	536.51	45.59	538.45	361.23	181.12
550	5° 30′	15° 07.5′	274.36	12.07	546.18	48.16	548.30	368.01	184.56
560	5° 36′	15° 40.8′	279.30	12.74	555.82	50.81	558.14	374.81	188.01
570	5° 42′	16° 14.7′	284.24	13.43	565.43	53.56	567.97	381.61	191.47
580	5° 48′	16° 49.2′	289.17	14.15	575.02	56.41	577.78	388.43	194.93
590	5° 54′	17° 24.3′	294.09	14.89	584.58	59.35	587.58	395.25	198.41
600	6° 00′	18° 00.0′	299.02	15.65	594.11	62.39	597.37	402.09	201.90
610	6° 06′	18° 36.3′	303.93	16.44	603.60	65.53	607.15	408.94	205.40
620	6° 12′	19° 13.2′	308.84	17.26	613.06	68.77	616.90	415.80	208.91
630	6° 18′	19° 50.7′	313.74	18.11	622.48	72.11	626.65	422.67	212.43
640	6° 24′	20° 28.8′	318.64	18.98	631.87	75.56	636.37	429.56	215.96
650	6° 30′	21° 07.5′	323.53	19.87	641.22	79.11	646.08	436.46	219.51
660	6° 36′	21° 46.8′	328.42	20.80	650.53	82.77	655.77	443.38	223.07
670	6° 42′	22° 26.7′	333.29	21.75	659.79	86.53	665.44	450.31	226.65
680	6° 48′	23° 07.2′	338.16	22.73	669.01	90.41	675.09	457.26	230.24
690	6° 54′	23° 48.3′	343.02	23.74	678.18	94.39	684.72	464.23	233.85
700	7° 00′	24° 30.0′	347.88	24.78	687.31	98.48	694.33	471.22	237.47
710	7° 06′	25° 12.3′	352.72	25.85	696.38	102.68	703.91	478.22	241.12
720	7° 12′	25° 55.2′	357.56	26.95	705.40	107.00	713.47	485.25	244.78
730	7° 18′	26° 38.7′	362.38	28.07	714.37	111.42	723.01	492.30	248.46
740	7° 24′	27° 22.8′	367.20	29.23	723.28	115.97	732.52	499.37	252.16
750	7° 30′	28° 07.5′	372.01	30.42	732.13	120.62	742.00	506.46	255.88
760	7° 36′	28° 52.8′	376.80	31.64	740.92	125.39	751.45	513.58	259.63
770	7° 42′	29° 38.7′	381.59	32.88	749.64	130.28	760.88	520.72	263.40
780	7° 48′	30° 25.2′	386.36	34.17	758.30	135.29	770.27	527.89	267.19
790	7° 54′	31° 12.3′	391.13	35.48	766.89	140.41	779.63	535.09	271.01
800	8° 00′	32° 00.0′	395.88	36.82	775.40	145.65	788.96	542.32	274.85
810	8° 06′	32° 48.3′	400.61	38.20	783.85	151.01	798.26	549.57	278.72
820	8° 12′	33° 37.2′	405.34	39.61	792.21	156.48	807.52	556.86	282.63
830	8° 18′	34° 26.7′	410.05	41.05	800.50	162.08	816.74	564.18	286.56
840	8° 24′	35° 16.8′	414.75	42.52	808.71	167.80	825.93	571.54	290.52
850	8° 30′	36° 07.5′	419.43	44.03	816.83	173.63	835.08	578.93	294.52
860	8° 36′	36° 58.8′	424.10	45.57	824.86	179.59	844.18	586.36	298.55
870	8° 42′	37° 50.7′	428.75	47.15	832.80	185.66	853.25	593.83	302.62
880	8° 48′	38° 43.2′	433.39	48.76	840.65	191.86	862.27	601.34	306.72
890	8° 54′	39° 36.3′	438.01	50.40	848.41	198.17	871.24	608.90	310.87
900	9° 00′	40° 30.0′	442.61	52.08	856.06	204.61	880.17	616.49	315.05
910	9° 06′	41° 24.3′	447.19	53.79	863.61	211.16	889.05	624.14	319.28
920	9° 12′	42° 19.2′	451.76	55.54	871.06	217.84	897.89	631.83	323.55
930	9° 18′	43° 14.7′	456.31	57.32	878.40	224.63	906.67	639.57	327.87
940	9° 24′	44° 10.8′	460.84	59.14	885.63	231.54	915.39	647.37	332.23
950	9° 30′	45° 07.5′	465.35	60.99	892.74	238.57	924.07	655.21	336.65
960	9° 36′	46° 04.8′	469.83	62.87	899.74	245.71	932.69	663.12	341.12
970	9° 42′	47° 02.7′	474.30	64.80	906.61	252.97	941.25	671.08	345.64
980	9° 48′	48° 01.2′	478.75	66.75	913.37	260.35	949.75	679.11	350.22
990	9° 54′	49° 00.3′	483.17	68.75	919.99	267.84	958.19	687.20	354.86
1000	10° 00′	50° 00.0′	487.57	70.78	926.48	275.44	966.56	695.36	359.57

THE STANDARD HIGHWAY SPIRAL

a = 1.25

L	D	S	q	p	Y	X	C	U	V
10	0° 07.5′	0° 00.4′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 15.0′	0° 01.5′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 22.5′	0° 03.4′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 30.0′	0° 06.0′	20.00	0.01	40.00	0.02	40.00	26.67	13.33
50	0° 37.5′	0° 09.4′	25.00	0.01	50.00	0.05	50.00	33.33	16.67
60	0° 45.0′	0° 13.5′	30.00	0.02	60.00	0.08	60.00	40.00	20.00
70	0° 52.5′	0° 18.4′	35.00	0.03	70.00	0.12	70.00	46.67	23.33
80	1° 00.0′	0° 24.0′	40.00	0.05	80.00	0.19	80.00	53.33	26.67
90	1° 07.5′	0° 30.4′	45.00	0.07	90.00	0.27	90.00	60.00	30.00
100	1° 15.0′	0° 37.5′	50.00	0.09	100.00	0.36	100.00	66.67	33.33
110	1° 22.5′	0° 45.4′	55.00	0.12	110.00	0.48	110.00	73.33	36.67
120	1° 30.0′	0° 54.0′	60.00	0.16	120.00	0.63	120.00	80.00	40.00
130	1° 37.5′	1° 03.4′	65.00	0.20	130.00	0.80	130.00	86.67	43.33
140	1° 45.0′	1° 13.5′	70.00	0.25	139.99	1.00	140.00	93.34	46.67
150	1° 52.5′	1° 24.4′	75.00	0.31	149.99	1.23	150.00	100.00	50.00
160	2° 00.0′	1° 36.0′	80.00	0.37	159.99	1.49	159.99	106.67	53.34
170	2° 07.5′	1° 48.4′	85.00	0.45	169.98	1.79	169.99	113.34	56.67
180	2° 15.0′	2° 01.5′	90.00	0.53	179.98	2.12	179.99	120.01	60.01
190	2° 22.5′	2° 15.4′	95.00	0.62	189.97	2.49	189.99	126.68	63.34
200	2° 30.0′	2° 30.0′	99.99	0.73	199.96	2.91	199.98	133.35	66.68
210	2° 37.5′	2° 45.4′	104.99	0.84	209.95	3.37	209.98	140.02	70.02
220	2° 45.0′	3° 01.5′	109.99	0.97	219.94	3.87	219.97	146.69	73.35
230	2° 52.5′	3° 18.4′	114.99	1.11	229.92	4.42	229.97	153.36	76.69
240	3° 00.0′	3° 36.0′	119.98	1.26	239.91	5.03	239.96	160.03	80.03
250	3° 07.5′	3° 54.4′	124.98	1.42	249.88	5.68	249.95	166.71	83.37
260	3° 15.0′	4° 13.5′	129.98	1.60	259.86	6.39	259.94	173.38	86.71
270	3° 22.5′	4° 33.4′	134.97	1.79	269.83	7.15	269.92	180.06	90.05
280	3° 30.0′	4° 54.0′	139.97	1.99	279.80	7.98	279.91	186.74	93.40
290	3° 37.5′	5° 15.4′	144.96	2.22	289.76	8.86	289.89	193.42	96.74
300	3° 45.0′	5° 37.5′	149.95	2.45	299.71	9.81	299.87	200.10	100.09
310	3° 52.5′	6° 00.4′	154.94	2.71	309.66	10.82	309.85	206.79	103.44
320	4° 00.0′	6° 24.0′	159.93	2.98	319.60	11.90	319.82	213.47	106.79
330	4° 07.5′	6° 48.4′	164.92	3.27	329.53	13.05	329.79	220.16	110.15
340	4° 15.0′	7° 13.5′	169.91	3.57	339.46	14.28	339.76	226.86	113.51
350	4° 22.5′	7° 39.4′	174.90	3.89	349.38	15.57	349.72	233.55	116.87
360	4° 30.0′	8° 06.0′	179.88	4.24	359.28	16.94	359.68	240.25	120.23
370	4° 37.5′	8° 33.4′	184.86	4.60	369.18	18.39	369.63	246.96	123.60
380	4° 45.0′	9° 01.5′	189.84	4.98	379.06	19.92	379.58	253.66	126.97
390	4° 52.5′	9° 30.4′	194.82	5.39	388.93	21.53	389.52	260.38	130.34
400	5° 00.0′	10° 00.0′	199.80	5.81	398.78	23.22	399.46	267.09	133.72
410	5° 07.5′	10° 30.4′	204.77	6.26	408.62	25.00	409.39	273.82	137.11
420	5° 15.0′	11° 01.5′	209.74	6.73	418.45	26.87	419.31	280.54	140.50
430	5° 22.5′	11° 33.4′	214.71	7.22	428.25	28.83	429.22	287.28	143.89
440	5° 30.0′	12° 06.0′	219.67	7.73	438.04	30.88	439.12	294.02	147.29
450	5° 37.5′	12° 39.4′	224.63	8.27	447.81	33.02	449.02	300.77	150.70
460	5° 45.0′	13° 13.5′	229.59	8.83	457.56	35.26	458.91	307.53	154.12
470	5° 52.5′	13° 48.4′	234.55	9.42	467.28	37.59	468.79	314.29	157.54
480	6° 00.0′	14° 24.0′	239.50	10.03	476.98	40.03	478.65	321.07	160.97
490	6° 07.5′	15° 00.4′	244.44	10.67	486.65	42.57	488.51	327.85	164.41
500	6° 15.0′	15° 37.5′	249.38	11.33	496.29	45.21	498.35	334.64	167.86

THE STANDARD HIGHWAY SPIRAL

a = 1.25—Continued

L	D	S	q	p	Y	X	C	U	V
510	6° 22.5′	16° 15.4′	254.32	12.02	505.91	47.96	508.18	341.44	171.31
520	6° 30.0′	16° 54.0′	259.25	12.74	515.49	50.81	517.99	348.26	174.78
530	6° 37.5′	17° 33.4′	264.17	13.49	525.05	53.77	527.79	355.09	178.26
540	6° 45.0′	18° 13.5′	269.09	14.26	534.56	56.84	527.58	361.93	181.75
550	6° 52.5′	18° 54.4′	274.00	15.07	544.04	60.03	547.34	368.78	185.26
560	7° 00.0′	19° 36.0′	278.91	15.90	553.48	63.32	557.09	375.65	188.77
570	7° 07.5′	20° 18.4′	283.81	16.76	562.88	66.74	566.82	382.53	192.30
580	7° 15.0′	21° 01.5′	288.70	17.65	572.24	70.27	576.54	389.43	195.85
590	7° 22.5′	21° 45.4′	293.59	18.57	581.55	73.91	586.23	396.35	199.41
600	7° 30.0′	22° 30.0′	298.46	19.53	590.81	77.68	595.90	403.28	202.98
610	7° 37.5′	23° 15.4′	303.33	20.51	600.03	81.57	605.55	410.23	206.58
620	7° 45.0′	24° 01.5′	308.19	21.53	609.19	85.58	615.17	417.21	210.19
630	7° 52.5′	24° 48.4′	313.04	22.58	618.29	89.71	624.77	424.20	213.82
640	8° 00.0′	25° 36.0′	317.88	23.66	627.34	93.97	634.34	431.22	217.47
650	8° 07.5′	26° 24.4′	322.71	24.78	636.33	98.35	643.88	438.25	221.15
660	8° 15.0′	27° 13.5′	327.53	25.92	645.25	102.86	653.40	445.32	224.84
670	8° 22.5′	28° 03.4′	332.34	27.11	654.11	107.50	662.89	452.41	228.56
680	8° 30.0′	28° 54.0′	337.14	28.32	662.90	112.27	672.34	459.53	232.31
690	8° 37.5′	29° 45.4′	341.92	29.58	671.62	117.17	681.76	466.67	236.08
700	8° 45.0′	30° 37.5′	346.69	30.86	680.26	122.20	691.15	473.85	239.87
710	8° 52.5′	31° 30.4′	351.45	32.19	688.83	127.36	700.50	481.05	243.70
720	9° 00.0′	32° 24.0′	356.20	33.54	697.31	132.65	709.82	488.29	247.56
730	9° 07.5′	33° 18.4′	360.93	34.94	705.72	138.07	719.10	495.57	251.45
740	9° 15.0′	34° 13.5′	365.64	36.37	714.03	143.63	728.33	502.88	255.37
750	9° 22.5′	35° 09.4′	370.34	37.84	722.25	149.32	737.53	510.23	259.33
760	9° 30.0′	36° 06.0′	375.03	39.34	730.38	155.15	746.68	517.62	263.32
770	9° 37.5′	37° 03.4′	379.69	40.89	738.41	161.11	755.78	525.05	267.35
780	9° 45.0′	38° 01.5′	384.34	42.47	746.34	167.20	764.84	532.53	271.42
790	9° 52.5′	39° 00.4′	388.98	44.08	754.16	173.43	773.85	540.05	275.54
800	10° 00.0′	40° 00.0′	393.59	45.74	761.88	179.79	782.80	547.62	279.70
810	10° 07.5′	41° 00.4′	398.18	47.44	769.48	186.28	791.71	555.24	283.90
820	10° 15.0′	42° 01.5′	402.76	49.17	776.97	192.91	800.56	562.91	288.16
830	10° 22.5′	43° 03.4′	407.31	50.94	784.34	199.67	809.35	570.65	292.47
840	10° 30.0′	44° 06.0′	411.84	52.75	791.58	206.56	818.09	578.43	296.82
850	10° 37.5′	45° 09.4′	416.35	54.60	798.70	213.59	826.77	586.27	301.24
860	10° 45.0′	46° 13.5′	420.84	56.49	805.68	220.74	835.38	594.18	305.71
870	10° 52.5′	47° 18.4′	425.30	58.42	812.53	228.03	843.93	602.16	310.25
880	11° 00.0′	48° 24.0′	429.74	60.39	819.25	235.44	852.41	610.21	314.85
890	11° 07.5′	49° 30.4′	434.15	62.40	825.81	242.98	860.82	618.33	319.52

THE STANDARD HIGHWAY SPIRAL

$a = 1\frac{1}{3}$

L	D	S	q	p	Y	X	C	U	V
10	0° 08′	0° 00.4′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 16′	0° 01.6′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 24′	0° 03.6′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 32′	0° 06.4′	20.00	0.01	40.00	0.02	40.00	26.67	13.33
50	0° 40′	0° 10.0′	25.00	0.01	50.00	0.05	50.00	33.33	16.67
60	0° 48′	0° 14.4′	30.00	0.02	60.00	0.08	60.00	40.00	20.00
70	0° 56′	0° 19.6′	35.00	0.03	70.00	0.13	70.00	46.67	23.33
80	1° 04′	0° 25.6′	40.00	0.05	80.00	0.20	80.00	53.33	26.67
90	1° 12′	0° 32.4′	45.00	0.07	90.00	0.28	90.00	60.00	30.00
100	1° 20′	0° 40.0′	50.00	0.10	100.00	0.39	100.00	66.67	33.33
110	1° 28′	0° 48.4′	55.00	0.13	110.00	0.52	110.00	73.33	36.67
120	1° 36′	0° 57.6′	60.00	0.17	120.00	0.67	120.00	80.00	40.00
130	1° 44′	1° 07.6′	65.00	0.21	129.99	0.85	130.00	86.67	43.33
140	1° 52′	1° 18.4′	70.00	0.27	139.99	1.06	140.00	93.34	46.67
150	2° 00′	1° 30.0′	75.00	0.33	149.99	1.31	150.00	100.00	50.00
160	2° 08′	1° 42.4′	80.00	0.40	159.99	1.59	159.99	106.67	53.34
170	2° 16′	1° 55.6′	85.00	0.48	169.98	1.91	169.99	113.34	56.67
180	2° 24′	2° 09.6′	90.00	0.57	179.97	2.26	179.99	120.01	60.01
190	2° 32′	2° 24.4′	94.99	0.67	189.97	2.66	189.99	126.68	63.34
200	2° 40′	2° 40.0′	99.99	0.78	199.96	3.10	199.98	133.35	66.68
210	2° 48′	2° 56.4′	104.99	0.90	209.94	3.59	209.98	140.02	70.02
220	2° 56′	3° 13.6′	109.99	1.03	219.93	4.13	219.97	146.69	73.36
230	3° 04′	3° 31.6′	114.99	1.18	229.91	4.72	229.96	153.36	76.69
240	3° 12′	3° 50.4′	119.98	1.34	239.89	5.36	239.95	160.04	80.03
250	3° 20′	4° 10.0′	124.98	1.51	249.87	6.06	249.94	166.71	83.38
260	3° 28′	4° 30.4′	129.97	1.70	259.84	6.81	259.93	173.39	86.72
270	3° 36′	4° 51.6′	134.97	1.91	269.81	7.63	269.91	180.07	90.06
280	3° 44′	5° 13.6′	139.96	2.13	279.77	8.51	279.90	186.75	93.41
290	3° 52′	5° 36.4′	144.95	2.36	289.72	9.45	289.88	193.43	96.75
300	4° 00′	6° 00.0′	149.95	2.62	299.67	10.46	299.85	200.12	100.10
310	4° 08′	6° 24.4′	154.94	2.89	309.61	11.54	309.83	206.80	103.46
320	4° 16′	6° 49.6′	159.92	3.18	319.55	12.70	319.80	213.49	106.81
330	4° 24′	7° 15.6′	164.91	3.48	329.47	13.92	329.76	220.19	110.17
340	4° 32′	7° 42.4′	169.90	3.81	339.39	15.22	339.73	226.88	113.53
350	4° 40′	8° 10.0′	174.89	4.15	349.29	16.60	349.68	233.58	116.89
360	4° 48′	8° 38.4′	179.86	4.52	359.18	18.07	359.64	240.29	120.26
370	4° 56′	9° 07.6′	184.84	4.91	369.06	19.61	369.58	247.00	123.63
380	5° 04′	9° 37.6′	189.82	5.32	378.93	21.24	379.52	253.71	127.01
390	5° 12′	10° 08.4′	194.80	5.75	388.78	22.96	389.46	260.43	130.39
400	5° 20′	10° 40.0′	199.77	6.20	398.62	24.76	399.38	267.15	133.78
410	5° 28′	11° 12.4′	204.74	6.67	408.43	26.66	409.30	273.88	137.17
420	5° 36′	11° 45.6′	209.71	7.17	418.23	28.65	419.21	280.62	140.56
430	5° 44′	12° 19.6′	214.67	7.70	428.01	30.74	429.12	287.36	143.97
440	5° 52′	12° 54.4′	219.63	8.24	437.77	32.92	439.01	294.12	147.38
450	6° 00′	13° 30.0′	224.58	8.82	447.51	35.20	448.89	300.88	150.80
460	6° 08′	14° 06.4′	229.54	9.42	457.22	37.59	458.76	307.65	154.22
470	6° 16′	14° 43.6′	234.48	10.04	466.90	40.08	468.62	314.43	157.66
480	6° 24′	15° 21.6′	239.43	10.70	476.56	42.67	478.47	321.21	161.10
490	6° 32′	16° 00.4′	244.36	11.38	486.19	45.38	488.30	328.01	164.56
500	6° 40′	16° 40.0′	249.30	12.08	495.79	48.19	498.12	334.82	168.02

THE STANDARD HIGHWAY SPIRAL

a = 1⅓—Continued

L	D	S	q	p	Y	X	C	U	V
510	6° 48′	17° 20.4′	254.22	12.82	505.35	51.11	507.93	341.65	171.50
520	6° 56′	18° 01.6′	259.14	13.59	514.88	54.15	517.72	348.48	174.98
530	7° 04′	18° 43.6′	264.06	14.38	524.37	57.30	527.49	355.33	178.48
540	7° 12′	19° 26.4′	268.97	15.21	533.82	60.57	537.24	362.20	182.00
550	7° 20′	20° 10.0′	273.87	16.06	543.23	63.96	546.98	369.07	185.52
560	7° 28′	20° 54.4′	278.76	16.95	552.59	67.47	556.69	375.97	189.07
570	7° 36′	21° 39.6′	283.65	17.87	561.91	71.10	566.39	382.88	192.62
580	7° 44′	22° 25.6′	288.53	18.82	571.18	74.85	576.06	389.82	196.20
590	7° 52′	23° 12.4′	293.39	19.80	580.39	78.73	585.71	396.77	199.79
600	8° 00′	24° 00.0′	298.25	20.81	589.56	82.73	595.33	403.74	203.40
610	8° 08′	24° 48.4′	303.10	21.86	598.66	86.86	604.93	410.73	207.03
620	8° 16′	25° 37.6′	307.94	22.94	607.71	91.12	614.51	417.75	210.69
630	8° 24′	26° 27.6′	312.77	24.06	616.70	95.51	624.05	424.79	214.36
640	8° 32′	27° 18.4′	317.59	25.21	625.62	100.04	633.56	431.86	218.06
650	8° 40′	28° 10.0′	322.40	26.40	634.47	104.69	643.05	438.95	221.78
660	8° 48′	29° 02.4′	327.19	27.62	643.25	109.48	652.50	446.07	225.53
670	8° 56′	29° 55.6′	331.98	28.88	651.95	114.40	661.91	453.22	229.30
680	9° 04′	30° 49.6′	336.75	30.17	660.58	119.45	671.29	460.40	233.11
690	9° 12′	31° 44.4′	341.50	31.51	669.12	124.65	680.63	467.62	236.94
700	9° 20′	32° 40.0′	346.24	32.87	677.59	129.98	689.94	474.87	240.81
710	9° 28′	33° 36.4′	350.97	34.28	685.96	135.44	699.20	482.15	244.71
720	9° 36′	34° 33.6′	355.68	35.72	694.24	141.05	708.42	489.48	248.64
730	9° 44′	35° 31.6′	360.37	37.21	702.43	146.79	717.60	496.84	252.61
740	9° 52′	36° 30.4′	365.05	38.73	710.52	152.67	726.73	504.25	256.62
750	10° 00′	37° 30.0′	369.71	40.29	718.50	158.69	735.82	511.70	260.67
760	10° 08′	38° 30.4′	374.35	41.88	726.38	164.84	744.85	519.20	264.76
770	10° 16′	39° 31.6′	378.97	43.52	734.16	171.14	753.84	526.74	268.90
780	10° 24′	40° 33.6′	383.58	45.20	741.81	177.57	762.77	534.34	273.08
790	10° 32′	41° 36.4′	388.16	46.92	749.35	184.14	771.64	541.99	277.32
800	10° 40′	42° 40.0′	392.72	48.67	756.76	190.85	780.46	549.70	281.60
810	10° 48′	43° 44.4′	397.26	50.47	764.05	197.70	789.21	557.46	285.94
820	10° 56′	44° 49.6′	401.78	52.31	771.21	204.68	797.91	565.29	290.34
830	11° 04′	45° 55.6′	406.27	54.19	778.23	211.80	806.54	573.18	294.80
840	11° 12′	47° 02.4′	410.74	56.11	785.12	219.05	815.10	581.14	299.31
850	11° 20′	48° 10.0′	415.18	58.07	791.86	226.43	823.60	589.17	303.90
860	11° 28′	49° 18.4′	419.60	60.07	798.46	233.95	832.03	597.28	308.55

THE STANDARD HIGHWAY SPIRAL

a = 1.5

L	D	S	q	p	Y	X	C	U	V
10	0° 09′	0° 00.5′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 18′	0° 01.8′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 27′	0° 04.1′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 36′	0° 07.2′	20.00	0.01	40.00	0.03	40.00	26.67	13.33
50	0° 45′	0° 11.3′	25.00	0.01	50.00	0.05	50.00	33.33	16.67
60	0° 54′	0° 16.2′	30.00	0.02	60.00	0.09	60.00	40.00	20.00
70	1° 03′	0° 22.1′	35.00	0.04	70.00	0.15	70.00	46.67	23.33
80	1° 12′	0° 28.8′	40.00	0.06	80.00	0.22	80.00	53.33	26.67
90	1° 21′	0° 36.5′	45.00	0.08	90.00	0.32	90.00	60.00	30.00
100	1° 30′	0° 45.0′	50.00	0.11	100.00	0.44	100.00	66.67	33.33
110	1° 39′	0° 54.5′	55.00	0.15	110.00	0.58	110.00	73.33	36.67
120	1° 48′	1° 04.8′	60.00	0.19	120.00	0.75	120.00	80.00	40.00
130	1° 57′	1° 16.0′	65.00	0.24	129.99	0.96	130.00	86.67	43.34
140	2° 06′	1° 28.2′	70.00	0.30	139.99	1.20	140.00	93.34	46.67
150	2° 15′	1° 41.2′	75.00	0.37	149.99	1.47	149.99	100.00	50.00
160	2° 24′	1° 55.2′	80.00	0.45	159.98	1.79	159.99	106.67	53.34
170	2° 33′	2° 10.0′	85.00	0.54	169.98	2.14	169.99	113.34	56.67
180	2° 42′	2° 25.8′	89.99	0.64	179.97	2.54	179.99	120.01	60.01
190	2° 51′	2° 42.5′	94.99	0.75	189.96	2.99	189.98	126.68	63.35
200	3° 00′	3° 00.0′	99.99	0.87	199.95	3.49	199.98	133.35	66.68
210	3° 09′	3° 18.5′	104.99	1.01	209.93	4.04	209.97	140.02	70.02
220	3° 18′	3° 37.8′	109.99	1.16	219.91	4.64	219.96	146.70	73.36
230	3° 27′	3° 58.1′	114.98	1.33	229.89	5.31	229.95	153.37	76.70
240	3° 36′	4° 19.2′	119.98	1.51	239.86	6.03	239.94	160.05	80.04
250	3° 45′	4° 41.3′	124.97	1.70	249.83	6.81	249.93	166.73	83.39
260	3° 54′	5° 04.2′	129.97	1.92	259.80	7.66	259.91	173.40	86.73
270	4° 03′	5° 28.1′	134.96	2.15	269.75	8.58	269.89	180.09	90.08
280	4° 12′	5° 52.8′	139.95	2.39	279.71	9.57	279.87	186.77	93.43
290	4° 21′	6° 18.5′	144.94	2.66	289.65	10.63	289.84	193.46	96.78
300	4° 30′	6° 45.0′	149.93	2.94	299.58	11.77	299.81	200.15	100.13
310	4° 39′	7° 12.5′	154.92	3.25	309.51	12.98	309.78	206.84	103.49
320	4° 48′	7° 40.8′	159.90	3.57	319.43	14.28	319.74	213.53	106.85
330	4° 57′	8° 10.1′	164.89	3.92	329.33	15.66	329.70	220.23	110.21
340	5° 06′	8° 40.2′	169.87	4.28	339.22	17.12	339.65	226.94	113.58
350	5° 15′	9° 11.3′	174.85	4.67	349.10	18.67	349.60	233.65	116.95
360	5° 24′	9° 43.2′	179.83	5.08	358.97	20.32	359.54	240.36	120.33
370	5° 33′	10° 16.1′	184.80	5.52	368.81	22.05	369.47	247.08	123.71
380	5° 42′	10° 49.8′	189.77	5.98	378.64	23.88	379.40	253.81	127.10
390	5° 51′	11° 24.5′	194.74	6.46	388.46	25.81	389.31	260.54	130.49
400	6° 00′	12° 00.0′	199.71	6.97	398.25	27.84	399.22	267.28	133.89
410	6° 09′	12° 36.5′	204.67	7.51	408.02	29.97	409.12	274.03	137.30
420	6° 18′	13° 13.8′	209.63	8.07	417.77	32.20	419.01	280.79	140.71
430	6° 27′	13° 52.1′	214.58	8.65	427.49	34.55	428.88	287.55	144.14
440	6° 36′	14° 31.2′	219.53	9.27	437.18	37.00	438.75	294.32	147.57
450	6° 45′	15° 11.3′	224.47	9.92	446.85	39.56	448.60	301.11	151.01
460	6° 54′	15° 52.2′	229.41	10.59	456.48	42.24	458.43	307.91	154.46
470	7° 03′	16° 34.1′	234.35	11.29	466.09	45.03	468.26	314.72	157.93
480	7° 12′	17° 16.8′	239.27	12.02	475.65	47.94	478.06	321.54	161.40
490	7° 21′	18° 00.5′	244.19	12.79	485.18	50.97	487.85	328.37	164.89
500	7° 30′	18° 45.0′	249.11	13.58	494.67	54.13	497.62	335.22	168.39

THE STANDARD HIGHWAY SPIRAL

a = 1.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	7° 39′	19° 30.5′	254.02	14.41	504.12	57.40	507.38	342.09	171.90
520	7° 48′	20° 16.8′	258.92	15.27	513.52	60.80	517.11	348.97	175.43
530	7° 57′	21° 04.1′	263.81	16.16	522.88	64.34	526.82	355.87	178.97
540	8° 06′	21° 52.2′	268.69	17.09	532.19	67.99	536.51	362.79	182.54
550	8° 15′	22° 41.3′	273.57	18.05	541.44	71.79	546.18	369.72	186.12
560	8° 24′	23° 31.2′	278.43	19.04	550.64	75.71	555.82	376.68	189.72
570	8° 33′	24° 22.1′	283.29	20.07	559.78	79.77	565.43	383.66	193.34
580	8° 42′	25° 13.8′	288.14	21.14	568.85	83.96	575.02	390.67	196.98
590	8° 51′	26° 06.5′	292.97	22.24	577.87	88.29	584.57	397.70	200.64
600	9° 00′	27° 00.0′	297.79	23.38	586.81	92.76	594.10	404.75	204.33
610	9° 09′	27° 54.5′	302.60	24.55	595.69	97.37	603.59	411.84	208.04
620	9° 18′	28° 49.8′	307.40	25.76	604.49	102.12	613.05	418.95	211.78
630	9° 27′	29° 46.1′	312.19	27.01	613.21	107.02	622.47	426.10	215.55
640	9° 36′	30° 43.2′	316.96	28.30	621.84	112.05	631.86	433.27	219.35
650	9° 45′	31° 41.3′	321.71	29.63	630.40	117.24	641.20	440.49	223.18
660	9° 54′	32° 40.2′	326.46	31.00	638.86	122.56	650.51	447.73	227.05
670	10° 03′	33° 40.1′	331.18	32.41	647.23	128.03	659.77	455.02	230.95
680	10° 12′	34° 40.8′	335.89	33.85	655.51	133.65	668.99	462.35	234.89
690	10° 21′	35° 42.5′	340.58	35.34	663.68	139.41	678.16	469.72	238.86
700	10° 30′	36° 45.0′	345.25	36.87	671.74	145.32	687.28	477.14	242.88
710	10° 39′	37° 48.5′	349.91	38.44	679.70	151.38	696.35	484.60	246.94
720	10° 48′	38° 52.8′	354.54	40.05	687.55	157.58	705.37	492.11	251.05
730	10° 57′	39° 58.1′	359.16	41.71	695.27	163.93	714.33	499.68	255.20
740	11° 06′	41° 04.2′	363.75	43.40	702.87	170.43	723.24	507.30	259.41
750	11° 15′	42° 11.3′	368.32	45.14	710.35	177.07	732.08	514.98	263.67
760	11° 24′	43° 19.2′	372.87	46.92	717.69	183.86	740.87	522.72	267.99
770	11° 33′	44° 28.1′	377.40	48.74	724.90	190.79	749.58	530.52	272.36
780	11° 42′	45° 37.8′	381.90	50.61	731.96	197.87	758.23	538.40	276.80
790	11° 51′	46° 48.5′	386.37	52.52	738.88	205.09	766.81	546.34	281.31
800	12° 00′	48° 00.0′	390.82	54.47	745.65	212.45	775.32	554.36	285.88
810	12° 09′	49° 12.5′	395.24	56.46	752.26	219.95	783.76	562.45	290.53

THE STANDARD HIGHWAY SPIRAL

a = 1.75

L	D	S	q	p	Y	X	C	U	V
10	0° 10.5′	0° 00.5′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 21.0′	0° 02.1′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 31.5′	0° 04.7′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0° 42.0′	0° 08.4′	20.00	0.01	40.00	0.03	40.00	26.67	13.33
50	0° 52.5′	0° 13.1′	25.00	0.02	50.00	0.06	50.00	33.33	16.67
60	1° 03.0′	0° 18.9′	30.00	0.03	60.00	0.11	60.00	40.00	20.00
70	1° 13.5′	0° 25.7′	35.00	0.04	70.00	0.17	70.00	46.67	23.33
80	1° 24.0′	0° 33.6′	40.00	0.06	80.00	0.26	80.00	53.33	26.67
90	1° 34.5′	0° 42.5′	45.00	0.09	90.00	0.37	90.00	60.00	30.00
100	1° 45.0′	0° 52.5′	50.00	0.13	100.00	0.51	100.00	66.67	33.33
110	1° 55.5′	1° 03.5′	55.00	0.17	110.00	0.68	110.00	73.33	36.67
120	2° 06.0′	1° 15.6′	60.00	0.22	119.99	0.88	120.00	80.00	40.00
130	2° 16.5′	1° 28.7′	65.00	0.28	129.99	1.12	130.00	86.67	43.34
140	2° 27.0′	1° 42.9′	70.00	0.35	139.99	1.40	139.99	93.34	46.67
150	2° 37.5′	1° 58.1′	75.00	0.43	149.98	1.72	149.99	100.01	50.01
160	2° 48.0′	2° 14.4′	80.00	0.52	159.98	2.08	159.99	106.68	53.34
170	2° 58.5′	2° 31.7′	84.99	0.63	169.97	2.50	169.99	113.35	56.68
180	3° 09.0′	2° 50.1′	89.99	0.74	179.96	2.97	179.98	120.02	60.01
190	3° 19.5′	3° 09.5′	94.99	0.87	189.94	3.49	189.97	126.69	63.35
200	3° 30.0′	3° 30.0′	99.99	1.02	199.93	4.07	199.97	133.36	66.69
210	3° 40.5′	3° 51.5′	104.98	1.18	209.91	4.71	209.96	140.03	70.03
220	3° 51.0′	4° 14.1′	109.98	1.35	219.88	5.42	219.95	146.71	73.37
230	4° 01.5′	4° 37.7′	114.97	1.55	229.85	6.19	229.93	153.39	76.71
240	4° 12.0′	5° 02.4′	119.97	1.76	239.81	7.03	239.92	160.07	80.06
250	4° 22.5′	5° 28.1′	124.96	1.99	249.77	7.95	249.90	166.75	83.41
260	4° 33.0′	5° 54.9′	129.95	2.24	259.72	8.94	259.88	173.43	86.76
270	4° 43.5′	6° 22.7′	134.94	2.50	269.67	10.01	269.85	180.12	90.11
280	4° 54.0′	6° 51.6′	139.93	2.79	279.60	11.16	279.82	186.81	93.46
290	5° 04.5′	7° 21.5′	144.92	3.10	289.52	12.40	289.79	193.50	96.82
300	5° 15.0′	7° 52.5′	149.91	3.43	299.43	13.73	299.75	200.20	100.18
310	5° 25.5′	8° 24.5′	154.89	3.78	309.33	15.14	309.70	206.90	103.55
320	5° 36.0′	8° 57.6′	159.87	4.17	319.22	16.65	319.65	213.61	106.92
330	5° 46.5′	9° 31.7′	164.85	4.57	329.09	18.26	329.59	220.32	110.29
340	5° 57.0′	10° 06.9′	169.82	5.00	338.94	19.96	339.53	227.04	113.67
350	6° 07.5′	10° 43.1′	174.80	5.45	348.78	21.77	349.46	233.76	117.06
360	6° 18.0′	11° 20.4′	179.77	5.93	358.59	23.68	359.37	240.49	120.45
370	6° 28.5′	11° 58.7′	184.73	6.44	368.39	25.70	369.28	247.23	123.85
380	6° 39.0′	12° 38.1′	189.69	6.97	378.16	27.84	379.18	253.98	127.26
390	6° 49.5′	13° 18.5′	194.65	7.53	387.90	30.08	389.07	260.74	130.67
400	7° 00.0′	14° 00.0′	199.60	8.13	397.62	32.44	398.94	267.51	134.10
410	7° 10.5′	14° 42.5′	204.55	8.75	407.31	34.92	408.80	274.28	137.53
420	7° 21.0′	15° 26.1′	209.49	9.40	416.96	37.52	418.65	281.07	140.97
430	7° 31.5′	16° 10.7′	214.43	10.09	426.58	40.24	428.48	287.87	144.43
440	7° 42.0′	16° 56.4′	219.36	10.81	436.17	43.09	438.29	294.69	147.90
450	7° 52.5′	17° 43.1′	224.28	11.56	445.72	46.07	448.09	301.52	151.38
460	8° 03.0′	18° 30.9′	229.20	12.34	455.22	49.18	457.87	308.36	154.87
470	8° 13.5′	19° 19.7′	234.11	13.16	464.68	52.42	467.63	315.22	158.38
480	8° 24.0′	20° 09.6′	239.01	14.01	474.09	55.80	477.37	322.10	161.91
490	8° 34.5′	21° 00.5′	243.91	14.90	483.45	59.32	487.08	329.00	165.45
500	8° 45.0′	21° 52.5′	248.79	15.83	492.76	62.97	496.77	335.91	169.02

THE STANDARD HIGHWAY SPIRAL

a = 1.75—Continued

L	D	S	q	p	Y	X	C	U	V
510	8° 55.5′	22° 45.5′	253.66	16.79	502.01	66.77	506.43	342.85	172.60
520	9° 06.0′	23° 39.6′	258.53	17.79	511.20	70.71	516.07	349.81	176.20
530	9° 16.5′	24° 34.7′	263.38	18.82	520.33	74.80	525.68	356.80	179.82
540	9° 27.0′	25° 30.9′	268.22	19.90	529.39	79.03	535.26	363.81	183.47
550	9° 37.5′	26° 28.1′	273.05	21.01	538.38	83.41	544.80	370.85	187.14
560	9° 48.0′	27° 26.4′	277.87	22.17	547.29	87.94	554.31	377.92	190.84
570	9° 58.5′	28° 25.7′	282.68	23.36	556.13	92.63	563.79	385.02	194.57
580	10° 09.0′	29° 26.1′	287.47	24.60	564.88	97.47	573.23	392.15	198.33
590	10° 19.5′	30° 27.5′	292.24	25.87	573.54	102.46	582.62	399.32	202.12
600	10° 30.0′	31° 30.0′	297.00	27.19	582.12	107.60	591.98	406.52	205.94
610	10° 40.5′	32° 33.5′	301.75	28.55	590.60	112.91	601.29	413.77	209.80
620	10° 51.0′	33° 38.1′	306.47	29.96	598.97	118.37	610.56	421.05	213.70
630	11° 01.5′	34° 43.7′	311.18	31.41	607.24	123.99	619.77	428.38	217.64
640	11° 12.0′	35° 50.4′	315.87	32.90	615.41	129.76	628.94	435.75	221.62
650	11° 22.5′	36° 58.1′	320.54	34.43	623.46	135.70	638.05	443.18	225.64
660	11° 33.0′	38° 06.9′	325.19	36.01	631.39	141.79	647.11	450.65	229.71
670	11° 43.5′	39° 16.7′	329.82	37.64	639.19	148.04	656.11	458.18	233.84
680	11° 54.0′	40° 27.6′	334.43	39.31	646.86	154.45	665.05	465.77	238.02
690	12° 04.5′	41° 39.5′	339.01	41.03	654.41	161.02	673.92	473.42	242.25
700	12° 15.0′	42° 52.5′	343.57	42.79	661.81	167.75	682.73	481.13	246.54
710	12° 25.5′	44° 06.5′	348.10	44.60	669.06	174.63	691.47	488.91	250.89
720	12° 36.0′	45° 21.6′	352.61	46.45	676.16	181.67	700.14	496.77	255.31
730	12° 46.5′	46° 37.7′	357.09	48.35	683.11	188.86	708.74	504.70	259.81
740	12° 57.0′	47° 54.9′	361.54	50.30	689.90	196.20	717.25	512.71	264.37
750	13° 07.5′	49° 13.1′	365.96	52.30	696.51	203.70	725.69	520.80	269.01

THE STANDARD HIGHWAY SPIRAL

a = 2.0

L	D	S	q	p	Y	X	C	U	V
10	0° 12′	0° 00.6′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 24′	0° 02.4′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0° 36′	0° 05.4′	15.00	0.00	30.00	0.02	30.00	20.00	10.00
40	0° 48′	0° 09.6′	20.00	0.01	40.00	0.04	40.00	26.67	13.33
50	1° 00′	0° 15.0′	25.00	0.02	50.00	0.07	50.00	33.33	16.67
60	1° 12′	0° 21.6′	30.00	0.03	60.00	0.13	60.00	40.00	20.00
70	1° 24′	0° 29.4′	35.00	0.05	70.00	0.20	70.00	46.67	23.33
80	1° 36′	0° 38.4′	40.00	0.07	80.00	0.30	80.00	53.33	26.67
90	1° 48′	0° 48.6′	45.00	0.11	90.00	0.42	90.00	60.00	30.00
100	2° 00′	1° 00.0′	50.00	0.15	100.00	0.58	100.00	66.67	33.33
110	2° 12′	1° 12.6′	55.00	0.19	110.00	0.77	110.00	73.34	36.67
120	2° 24′	1° 26.4′	60.00	0.25	119.99	1.01	120.00	80.00	40.00
130	2° 36′	1° 41.4′	65.00	0.32	129.99	1.28	129.99	86.67	43.34
140	2° 48′	1° 57.6′	70.00	0.40	139.98	1.60	139.99	93.34	46.67
150	3° 00′	2° 15.0′	75.00	0.49	149.98	1.96	149.99	100.01	50.01
160	3° 12′	2° 33.6′	79.99	0.60	159.97	2.38	159.99	106.68	53.34
170	3° 24′	2° 53.4′	84.99	0.71	169.96	2.86	169.98	113.35	56.68
180	3° 36′	3° 14.4′	89.99	0.85	179.94	3.39	179.97	120.02	60.02
190	3° 48′	3° 36.6′	94.99	1.00	189.92	3.99	189.97	126.69	63.36
200	4° 00′	4° 00.0′	99.98	1.16	199.90	4.65	199.96	133.37	66.70
210	4° 12′	4° 24.6′	104.98	1.35	209.88	5.39	209.94	140.04	70.04
220	4° 24′	4° 50.4′	109.97	1.55	219.84	6.19	219.93	146.72	73.38
230	4° 36′	5° 17.4′	114.97	1.77	229.80	7.07	229.91	153.40	76.73
240	4° 48′	5° 45.6′	119.96	2.01	239.76	8.04	239.89	160.08	80.08
250	5° 00′	6° 15.0′	124.95	2.27	249.70	9.08	249.87	166.77	83.43
260	5° 12′	6° 45.6′	129.94	2.56	259.64	10.22	259.84	173.46	86.78
270	5° 24′	7° 17.4′	134.93	2.86	269.56	11.44	269.81	180.15	90.14
280	5° 36′	7° 50.4′	139.91	3.19	279.48	12.75	279.77	186.85	93.50
290	5° 48′	8° 24.6′	144.90	3.54	289.38	14.17	289.72	193.55	96.87
300	6° 00′	9° 00.0′	149.88	3.92	299.26	15.68	299.67	200.26	100.24
310	6° 12′	9° 36.6′	154.85	4.33	309.13	17.30	309.61	206.97	103.61
320	6° 24′	10° 14.4′	159.83	4.76	318.98	19.02	319.55	213.69	106.99
330	6° 36′	10° 53.4′	164.80	5.22	328.81	20.85	329.47	220.42	110.38
340	6° 48′	11° 33.6′	169.77	5.71	338.62	22.80	339.39	227.15	113.77
350	7° 00′	12° 15.0′	174.73	6.23	348.40	24.86	349.29	233.89	117.18
360	7° 12′	12° 57.6′	179.69	6.77	358.16	27.04	359.18	240.65	120.59
370	7° 24′	13° 41.4′	184.65	7.35	367.89	29.35	369.06	247.41	124.01
380	7° 36′	14° 26.4′	189.60	7.96	377.59	31.78	378.93	254.18	127.44
390	7° 48′	15° 12.6′	194.54	8.61	387.26	34.34	388.78	260.96	130.88
400	8° 00′	16° 00.0′	199.48	9.28	396.89	37.03	398.62	267.76	134.33
410	8° 12′	16° 48.6′	204.41	9.99	406.48	39.85	408.43	274.58	137.80
420	8° 24′	17° 38.4′	209.34	10.74	416.04	42.81	418.23	281.41	141.28
430	8° 36′	18° 29.4′	214.26	11.52	425.54	45.91	428.01	288.25	144.77
440	8° 48′	19° 21.6′	219.17	12.34	435.00	49.15	437.77	295.11	148.28
450	9° 00′	20° 15.0′	224.07	13.19	444.41	52.54	447.51	301.99	151.81
460	9° 12′	21° 09.6′	228.96	14.09	453.77	56.08	457.22	308.89	155.35
470	9° 24′	22° 05.4′	233.84	15.02	463.06	59.76	466.90	315.81	158.92
480	9° 36′	23° 02.4′	238.71	15.99	472.30	63.60	476.56	322.75	162.51
490	9° 48′	24° 00.6′	243.57	17.00	481.46	67.59	486.19	329.72	166.12
500	10° 00′	25° 00.0′	248.42	18.06	490.56	71.74	495.78	336.72	169.75

THE STANDARD HIGHWAY SPIRAL

a = 2.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	10° 12′	26° 00.6′	253.26	19.15	499.59	76.04	505.34	343.74	173.41
520	10° 24′	27° 02.4′	258.08	20.29	508.54	80.51	514.37	350.80	177.10
530	10° 36′	28° 05.4′	262.89	21.47	517.40	85.14	524.36	357.89	180.81
540	10° 48′	29° 09.6′	267.69	22.69	526.18	89.93	533.81	365.01	184.56
550	11° 00′	30° 15.0′	272.47	23.96	534.87	94.88	543.22	372.17	188.34
560	11° 12′	31° 21.6′	277.23	25.27	543.45	100.00	552.58	379.36	192.16
570	11° 24′	32° 29.4′	281.97	26.63	551.94	105.29	561.90	386.60	196.02
580	11° 36′	33° 38.4′	286.70	28.03	560.32	110.75	571.16	393.89	199.91
590	11° 48′	34° 48.6′	291.41	29.48	568.59	116.37	580.38	401.22	203.85
600	12° 00′	36° 00.0′	296.10	30.98	576.74	122.16	589.54	408.60	207.84
610	12° 12′	37° 12.6′	300.76	32.52	584.77	128.13	598.64	416.03	211.87
620	12° 24′	38° 26.4′	305.41	34.11	592.67	134.26	607.69	423.52	215.96
630	12° 36′	39° 41.4′	310.03	35.75	600.43	140.56	616.67	431.07	220.10
640	12° 48′	40° 57.6′	314.63	37.44	608.05	147.03	625.58	438.68	224.29
650	13° 00′	42° 15.0′	319.20	39.18	615.53	153.67	634.43	446.35	228.55
660	13° 12′	43° 33.6′	323.74	40.96	622.86	160.48	643.20	454.10	232.88
670	13° 24′	44° 53.4′	328.26	42.80	630.03	167.45	651.90	461.93	237.27
680	13° 36′	46° 14.4′	332.75	44.68	637.03	174.59	660.52	469.83	241.74
690	13° 48′	47° 36.6′	337.21	46.62	643.86	181.90	669.06	477.82	246.28
700	14° 00′	49° 00.0′	341.64	48.60	650.51	189.36	677.51	485.90	250.91

THE STANDARD HIGHWAY SPIRAL

a = 2.5

L	D	S	q	p	Y	X	C	U	V
10	0° 15′	0° 00.7′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 30′	0° 03.0′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	0° 45′	0° 06.7′	15.00	0.00	30.00	0.02	30.00	20.00	10.00
40	1° 00′	0° 12.0′	20.00	0.01	40.00	0.05	40.00	26.67	13.33
50	1° 15′	0° 18.7′	25.00	0.02	50.00	0.09	50.00	33.33	16.67
60	1° 30′	0° 27.0′	30.00	0.04	60.00	0.16	60.00	40.00	20.00
70	1° 45′	0° 36.7′	35.00	0.06	70.00	0.25	70.00	46.67	23.33
80	2° 00′	0° 48.0′	40.00	0.09	80.00	0.37	80.00	53.33	26.67
90	2° 15′	1° 00.7′	45.00	0.13	90.00	0.53	90.00	60.00	30.00
100	2° 30′	1° 15.0′	50.00	0.18	100.00	0.73	100.00	66.67	33.33
110	2° 45′	1° 30.7′	55.00	0.24	109.99	0.97	110.00	73.34	36.67
120	3° 00′	1° 48.0′	60.00	0.31	119.99	1.26	119.99	80.00	40.00
130	3° 15′	2° 06.7′	65.00	0.40	129.98	1.60	129.99	86.67	43.34
140	3° 30′	2° 27.0′	70.00	0.50	139.97	2.00	139.99	93.34	46.67
150	3° 45′	2° 48.7′	74.99	0.61	149.96	2.45	149.98	100.01	50.01
160	4° 00′	3° 12.0′	79.99	0.74	159.95	2.98	159.98	106.68	53.35
170	4° 15′	3° 36.7′	84.99	0.89	169.93	3.57	169.97	113.36	56.69
180	4° 30′	4° 03.0′	89.99	1.06	179.91	4.24	179.96	120.03	60.03
190	4° 45′	4° 30.7′	94.98	1.25	189.88	4.99	189.95	126.71	63.37
200	5° 00′	5° 00.0′	99.97	1.45	199.85	5.81	199.93	133.39	66.72
210	5° 15′	5° 30.7′	104.97	1.68	209.81	6.73	209.91	140.07	70.06
220	5° 30′	6° 03.0′	109.96	1.94	219.75	7.74	219.89	146.75	73.41
230	5° 45′	6° 36.7′	114.95	2.21	229.69	8.84	229.86	153.44	76.76
240	6° 00′	7° 12.0′	119.94	2.51	239.62	10.04	239.83	160.13	80.12
250	6° 15′	7° 48.7′	124.92	2.84	249.54	11.35	249.79	166.83	83.48
260	6° 30′	8° 27.0′	129.91	3.19	259.44	12.76	259.75	173.53	86.85
270	6° 45′	9° 06.7′	134.89	3.58	269.32	14.29	269.70	180.24	90.22
280	7° 00′	9° 48.0′	139.86	3.99	279.18	15.93	279.64	186.95	93.59
290	7° 15′	10° 30.7′	144.84	4.43	289.03	17.69	289.57	193.68	96.98
300	7° 30′	11° 15.0′	149.81	4.90	298.85	19.58	299.49	200.41	100.37
310	7° 45′	12° 00.7′	154.77	5.41	308.64	21.60	309.40	207.14	103.77
320	8° 00′	12° 48.0′	159.73	5.95	318.41	23.75	319.29	213.89	107.18
330	8° 15′	13° 36.7′	164.69	6.52	328.14	26.03	329.17	220.65	110.59
340	8° 30′	14° 27.0′	169.64	7.13	337.84	28.45	339.04	227.43	114.02
350	8° 45′	15° 18.7′	174.58	7.78	347.51	31.02	348.89	234.21	117.47
360	9° 00′	16° 12.0′	179.52	8.46	357.13	33.74	358.72	241.01	120.92
370	9° 15′	17° 06.7′	184.45	9.18	366.71	36.60	368.54	247.83	124.39
380	9° 30′	18° 03.0′	189.37	9.94	376.25	39.62	378.33	254.66	127.88
390	9° 45′	19° 00.7′	194.29	10.74	385.73	42.80	388.09	261.52	131.38
400	10° 00′	20° 00.0′	199.19	11.59	395.15	46.14	397.84	268.39	134.90
410	10° 15′	21° 00.7′	204.08	12.47	404.52	49.64	407.55	275.28	138.44
420	10° 30′	22° 03.0′	208.97	13.40	413.82	53.31	417.24	282.20	142.01
430	10° 45′	23° 06.7′	213.84	14.37	423.06	57.15	426.90	289.15	145.59
440	11° 00′	24° 12.0′	218.70	15.39	432.22	61.16	436.52	296.12	149.21
450	11° 15′	25° 18.7′	223.54	16.45	441.30	65.35	446.11	303.13	152.85
460	11° 30′	26° 27.0′	228.38	17.56	450.29	69.72	455.66	310.16	156.52
470	11° 45′	27° 36.7′	233.19	18.72	459.20	74.26	465.17	317.23	160.22
480	12° 00′	28° 48.0′	237.99	19.93	468.01	78.98	474.63	324.34	163.95
490	12° 15′	30° 00.7′	242.78	21.18	476.72	83.89	484.05	331.49	167.73
500	12° 30′	31° 15.0′	247.54	22.49	485.33	88.99	493.42	338.68	171.54

THE STANDARD HIGHWAY SPIRAL

a = 2.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	12° 45′	32° 30.7′	252.29	23.84	493.82	94.27	502.74	345.92	175.39
520	13° 00′	33° 48.0′	257.01	25.25	502.19	99.74	512.00	353.20	179.29
530	13° 15′	35° 06.7′	261.72	26.71	510.44	105.40	521.21	360.54	183.24
540	13° 30′	36° 27.0′	266.40	28.22	518.55	111.24	530.35	367.94	187.24
550	13° 45′	37° 48.7′	271.06	29.78	526.52	117.28	539.43	375.40	191.30
560	14° 00′	39° 12.0′	275.69	31.40	534.35	123.50	548.44	382.92	195.41
570	14° 15′	40° 36.7′	280.29	33.07	542.02	129.92	557.37	390.51	199.59
580	14° 30′	42° 03.0′	284.87	34.80	549.53	136.52	566.23	398.17	203.83
590	14° 45′	43° 30.7′	289.42	36.58	556.87	143.31	575.01	405.91	208.15
600	15° 00′	45° 00.0′	293.94	38.42	564.03	150.29	583.71	413.74	212.55
610	15° 15′	46° 30.7′	298.42	40.31	571.01	157.46	592.32	421.65	217.02
620	15° 30′	48° 03.0′	302.87	42.26	577.79	164.80	600.84	429.66	221.59

THE STANDARD HIGHWAY SPIRAL

a = 3.0

L	D	S	q	p	Y	X	C	U	V
10	0° 18′	0° 00.9′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 36′	0° 03.6′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	0° 54′	0° 08.1′	15.00	0.01	30.00	0.02	30.00	20.00	10.00
40	1° 12′	0° 14.4′	20.00	0.01	40.00	0.06	40.00	26.67	13.33
50	1° 30′	0° 22.5′	25.00	0.03	50.00	0.11	50.00	33.33	16.67
60	1° 48′	0° 32.4′	30.00	0.05	60.00	0.19	60.00	40.00	20.00
70	2° 06′	0° 44.1′	35.00	0.08	70.00	0.30	70.00	46.67	23.33
80	2° 24′	0° 57.6′	40.00	0.11	80.00	0.45	80.00	53.33	26.67
90	2° 42′	1° 12.9′	45.00	0.16	90.00	0.64	90.00	60.00	30.00
100	3° 00′	1° 30.0′	50.00	0.22	99.99	0.87	100.00	66.67	33.34
110	3° 18′	1° 48.9′	55.00	0.29	109.99	1.16	110.00	73.34	36.67
120	3° 36′	2° 09.6′	60.00	0.38	119.98	1.51	119.99	80.01	40.01
130	3° 54′	2° 32.1′	65.00	0.48	129.97	1.92	129.99	86.68	43.34
140	4° 12′	2° 56.4′	69.99	0.60	139.96	2.39	139.98	93.35	46.68
150	4° 30′	3° 22.5′	74.99	0.74	149.95	2.94	149.98	100.02	50.02
160	4° 48′	3° 50.4′	79.99	0.89	159.93	3.57	159.97	106.69	53.36
170	5° 06′	4° 20.1′	84.98	1.07	169.90	4.29	169.96	113.37	56.70
180	5° 25′	4° 51.6′	89.98	1.27	179.87	5.09	179.94	120.05	60.04
190	5° 42′	5° 24.9′	94.97	1.50	189.83	5.98	189.92	126.73	63.39
200	6° 00′	6° 00.0′	99.96	1.74	199.78	6.98	199.90	133.41	66.74
210	6° 18′	6° 36.9′	104.95	2.02	209.72	8.07	209.88	140.10	70.09
220	6° 36′	7° 15.6′	109.94	2.32	219.65	9.28	219.84	146.79	73.45
230	6° 54′	7° 56.1′	114.93	2.65	229.56	10.60	229.80	153.49	76.81
240	7° 12′	8° 38.4′	119.91	3.01	239.45	12.04	239.76	160.19	80.17
250	7° 30′	9° 22.5′	124.89	3.41	249.33	13.61	249.70	166.90	83.55
260	7° 48′	10° 08.4′	129.86	3.83	259.19	15.30	259.64	173.62	86.93
270	8° 06′	10° 56.1′	134.84	4.29	269.02	17.13	269.56	180.34	90.31
280	8° 24′	11° 45.6′	139.80	4.78	278.82	19.10	279.48	187.08	93.71
290	8° 42′	12° 36.9′	144.77	5.31	288.60	21.21	289.38	193.83	97.12
300	9° 00′	13° 30.0′	149.72	5.88	298.34	23.47	299.26	200.59	100.53
310	9° 18′	14° 24.9′	154.67	6.48	308.04	25.88	309.13	207.36	103.96
320	9° 36′	15° 21.6′	159.62	7.13	317.71	28.45	318.98	214.14	107.40
330	9° 54′	16° 20.1′	164.55	7.82	327.33	31.18	328.81	220.94	110.86
340	10° 12′	17° 20.4′	169.48	8.55	336.90	34.08	338.62	227.76	114.33
350	10° 30′	18° 22.5′	174.40	9.32	346.42	37.14	348.40	234.60	117.82
360	10° 48′	19° 26.4′	179.31	10.14	355.88	40.38	358.16	241.46	121.33
370	11° 06′	20° 32.1′	184.21	11.00	365.28	43.80	367.89	248.35	124.86
380	11° 24′	21° 39.6′	189.10	11.91	374.61	47.40	377.59	255.26	128.42
390	11° 42′	22° 48.9′	193.97	12.87	383.86	51.18	387.26	262.19	132.00
400	12° 00′	24° 00.0′	198.83	13.88	393.04	55.15	396.89	269.16	135.60
410	12° 18′	25° 12.9′	203.68	14.93	402.13	59.32	406.48	276.16	139.24
420	12° 36′	26° 27.6′	208.51	16.04	411.13	63.68	416.03	283.20	142.91
430	12° 54′	27° 44.1′	213.33	17.20	420.03	68.23	425.54	290.27	146.61
440	13° 12′	29° 02.4′	218.13	18.41	428.83	72.98	435.00	297.38	150.35
450	13° 30′	30° 22.5′	222.91	19.68	437.52	77.94	444.41	304.54	154.13
460	13° 48′	31° 44.4′	227.67	21.00	446.08	83.10	453.76	311.75	157.96
470	14° 06′	33° 08.1′	232.40	22.38	454.52	88.46	463.05	319.01	161.83
480	14° 24′	34° 33.6′	237.12	23.82	462.83	94.03	472.28	326.32	165.76
490	14° 42′	36° 00.9′	241.81	25.31	470.99	99.81	481.45	333.69	169.74
500	15° 00′	37° 30.0′	246.47	26.86	479.00	105.79	490.55	341.13	173.78

THE STANDARD HIGHWAY SPIRAL

a = 3.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	15° 18′	39° 00.9′	251.11	28.47	486.85	111.98	499.57	348.64	177.88
520	15° 36′	40° 33.6′	255.72	30.13	494.54	118.38	508.51	356.23	182.06
530	15° 54′	42° 08.1′	260.29	31.86	502.05	124.99	517.37	363.89	186.30
540	16° 12′	43° 44.4′	264.84	33.65	509.37	131.80	526.14	371.64	190.63
550	16° 30′	45° 22.5′	269.35	35.50	516.49	138.81	534.82	379.48	195.04
560	16° 48′	47° 02.4′	273.83	37.40	523.41	146.03	543.40	387.43	199.54

THE STANDARD HIGHWAY SPIRAL

a = 3.5

L	D	S	q	p	Y	X	C	U	V
10	0° 21′	0° 01.1′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 42′	0° 04.2′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1° 03′	0° 09.5′	15.00	0.01	30.00	0.03	30.00	20.00	10.00
40	1° 24′	0° 16.8′	20.00	0.02	40.00	0.07	40.00	26.67	13.33
50	1° 45′	0° 26.3′	25.00	0.03	50.00	0.13	50.00	33.33	16.67
60	2° 06′	0° 37.8′	30.00	0.06	60.00	0.22	60.00	40.00	20.00
70	2° 27′	0° 51.5′	35.00	0.09	70.00	0.35	70.00	46.67	23.33
80	2° 48′	1° 07.2′	40.00	0.13	80.00	0.52	80.00	53.33	26.67
90	3° 09′	1° 25.1′	45.00	0.18	89.99	0.74	90.00	60.00	30.00
100	3° 30′	1° 45.0′	50.00	0.25	99.99	1.02	100.00	66.67	33.34
110	3° 51′	2° 07.1′	55.00	0.34	109.99	1.36	109.99	73.34	36.67
120	4° 12′	2° 31.2′	60.00	0.44	119.98	1.76	119.99	80.01	40.01
130	4° 33′	2° 57.5′	64.99	0.56	129.97	2.24	129.98	86.68	43.34
140	4° 54′	3° 25.8′	69.99	0.70	139.95	2.79	139.98	93.35	46.68
150	5° 15′	3° 56.3′	74.99	0.86	149.93	3.43	149.97	100.02	50.02
160	5° 36′	4° 28.8′	79.98	1.04	159.90	4.17	159.96	106.70	53.36
170	5° 57′	5° 03.5′	84.98	1.25	169.87	5.00	169.94	113.38	56.71
180	6° 18′	5° 40.2′	89.97	1.48	179.82	5.93	179.92	120.06	60.06
190	6° 39′	6° 19.1′	94.96	1.75	189.77	6.98	189.90	126.75	63.41
200	7° 00′	7° 00.0′	99.95	2.04	199.70	8.14	199.87	133.44	66.76
210	7° 21′	7° 43.1′	104.94	2.36	209.62	9.42	209.83	140.13	70.12
200	7° 42′	8° 28.2′	109.92	2.71	219.52	10.82	219.79	146.83	73.49
230	8° 03′	9° 15.5′	114.90	3.09	229.40	12.36	229.73	153.54	76.86
240	8° 24′	10° 04.8′	119.88	3.51	239.26	14.04	239.67	160.26	80.24
250	8° 45′	10° 56.3′	124.85	3.97	249.09	15.87	249.60	166.99	83.62
260	9° 06′	11° 49.8′	129.82	4.47	258.89	17.84	259.51	173.72	87.02
270	9° 27′	12° 45.5′	134.78	5.00	268.66	19.97	269.41	180.47	90.43
280	9° 48′	13° 43.2′	139.73	5.58	278.40	22.26	279.29	187.23	93.85
290	10° 09′	14° 43.1′	144.68	6.19	288.09	24.71	289.15	194.01	97.28
300	10° 30′	15° 45.0′	149.62	6.85	297.74	27.34	298.99	200.80	100.73
310	10° 51′	16° 49.1′	154.56	7.56	307.34	30.14	308.81	207.61	104.19
320	11° 12′	17° 55.2′	159.48	8.31	316.88	33.13	318.61	214.44	107.67
330	11° 33′	19° 03.5′	164.39	9.11	326.37	36.30	328.38	221.29	111.17
340	11° 54′	20° 13.8′	169.30	9.96	335.79	39.66	338.12	228.16	114.70
350	12° 15′	21° 26.3′	174.19	10.86	345.13	43.22	347.83	235.07	118.25
360	12° 36′	22° 40.8′	179.06	11.81	354.40	46.97	357.50	242.00	121.82
370	12° 57′	23° 57.5′	183.92	12.81	363.58	50.93	367.13	248.96	125.42
380	13° 18′	25° 16.2′	188.77	13.87	372.67	55.09	376.72	255.96	129.06
390	13° 39′	26° 37.1′	193.61	14.98	381.67	59.47	386.27	263.00	132.73
400	14° 00′	28° 00.0′	198.42	16.15	390.55	64.06	395.77	270.08	136.44
410	14° 21′	29° 25.1′	203.21	17.38	399.32	68.86	405.22	277.21	140.19
420	14° 42′	30° 52.2′	207.98	18.66	407.97	73.88	414.61	284.38	143.99
430	15° 03′	32° 21.5′	212.73	20.01	416.49	79.12	423.94	291.61	147.83
440	15° 24′	33° 52.8′	217.46	21.41	424.86	84.58	433.20	298.89	151.73
450	15° 45′	35° 26.3′	222.16	22.88	433.09	90.27	442.40	306.24	155.69
460	16° 06′	37° 01.8′	226.83	24.41	441.15	96.18	451.52	313.66	159.71
470	16° 27′	38° 39.5′	231.48	26.00	449.05	102.32	460.56	321.15	163.79
480	16° 48′	40° 19.2′	236.09	27.66	456.77	108.67	469.52	328.71	167.95
490	17° 09′	42° 01.1′	240.67	29.38	464.30	115.26	478.39	336.37	172.19
500	17° 30′	43° 45.0′	245.22	31.16	471.62	122.06	487.16	344.12	176.51

THE STANDARD HIGHWAY SPIRAL

a = 4.0

L	D	S	q	p	Y	X	C	U	V
10	0° 24′	0° 01.2′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 48′	0° 04.8′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1° 12′	0° 10.8′	15.00	0.01	30.00	0.03	30.00	20.00	10.00
40	1° 36′	0° 19.2′	20.00	0.02	40.00	0.07	40.00	26.67	13.33
50	2° 00′	0° 30.0′	25.00	0.04	50.00	0.15	50.00	33.33	16.67
60	2° 24′	0° 43.2′	30.00	0.06	60.00	0.25	60.00	40.00	20.00
70	2° 48′	0° 58.8′	35.00	0.10	70.00	0.40	70.00	46.67	23.33
80	3° 12′	1° 16.8′	40.00	0.15	80.00	0.60	80.00	53.33	26.67
90	3° 36′	1° 37.2′	45.00	0.21	89.99	0.85	90.00	60.00	30.00
100	4° 00′	2° 00.0′	50.00	0.29	99.99	1.16	99.99	66.67	33.34
110	4° 24′	2° 25.2′	55.00	0.39	109.98	1.55	109.99	73.34	36.67
120	4° 48′	2° 52.8′	59.99	0.50	119.97	2.01	119.99	80.01	40.01
130	5° 12′	3° 22.8′	64.99	0.64	129.96	2.56	129.98	86.68	43.35
140	5° 36′	3° 55.2′	69.99	0.80	139.94	3.19	139.97	93.36	46.69
150	6° 00′	4° 30.0′	74.98	0.98	149.91	3.93	149.96	100.03	50.03
160	6° 24′	5° 07.2′	79.98	1.19	159.87	4.76	159.94	106.71	53.37
170	6° 48′	5° 46.8′	84.97	1.43	169.83	5.71	169.92	113.39	56.72
180	7° 12′	6° 28.8′	89.96	1.70	179.77	6.78	179.90	120.08	60.07
190	7° 36′	7° 13.2′	94.95	1.99	189.70	7.97	189.87	126.77	63.43
200	8° 00′	8° 00.0′	99.94	2.33	199.61	9.30	199.83	133.47	66.79
210	8° 24′	8° 49.2′	104.92	2.69	209.50	10.76	209.78	140.17	70.16
220	8° 48′	9° 40.8′	109.90	3.09	219.37	12.36	219.72	146.89	73.53
230	9° 12′	10° 34.8′	114.87	3.53	229.22	14.12	229.65	153.61	76.92
240	9° 36′	11° 31.2′	119.84	4.02	239.03	16.04	239.57	160.34	80.31
250	10° 00′	12° 30.0′	124.80	4.54	248.81	18.12	249.47	167.08	83.71
260	10° 24′	13° 31.2′	129.76	5.10	258.56	20.37	259.36	173.84	87.13
270	10° 48′	14° 34.8′	134.71	5.71	268.26	22.80	269.22	180.61	90.56
280	11° 12′	15° 40.8′	139.65	6.37	277.91	25.41	279.07	187.40	94.00
290	11° 36′	16° 49.2′	144.58	7.07	287.51	28.21	288.89	194.21	97.47
300	12° 00′	18° 00.0′	149.51	7.83	297.05	31.20	298.69	201.04	100.95
310	12° 24′	19° 13.2′	154.42	8.63	306.53	34.39	308.45	207.90	104.45
320	12° 48′	20° 28.8′	159.32	9.49	315.94	37.78	318.19	214.78	107.98
330	13° 12′	21° 46.8′	164.21	10.40	325.26	41.38	327.89	221.69	111.54
340	13° 36′	23° 07.2′	169.08	11.37	334.50	45.20	337.55	228.63	115.12
350	14° 00′	24° 30.0′	173.94	12.39	343.65	49.24	347.16	235.61	118.74
360	14° 24′	25° 55.2′	178.78	13.47	352.70	53.50	356.74	242.62	122.39
370	14° 48′	27° 22.8′	183.60	14.61	361.64	57.98	366.26	249.68	126.08
380	15° 12′	28° 52.8′	188.40	15.82	370.46	62.70	375.73	256.79	129.81
390	15° 36′	30° 25.2′	193.18	17.08	379.15	67.64	385.14	263.95	133.59
400	16° 00′	32° 00.0′	197.94	18.41	387.70	72.82	394.48	271.16	137.43
410	16° 24′	33° 37.2′	202.67	19.80	396.11	78.24	403.76	278.43	141.31
420	16° 48′	35° 16.8′	207.37	21.26	404.35	83.90	412.97	285.77	145.26
430	17° 12′	36° 58.8′	212.05	22.79	412.43	89.79	422.09	293.18	149.27
440	17° 36′	38° 43.2′	216.69	24.38	420.33	95.93	431.13	300.67	153.36
450	18° 00′	40° 30.0′	221.30	26.04	428.03	102.30	440.09	308.25	157.52
460	18° 24′	42° 19.2′	225.88	27.77	435.53	108.92	448.95	315.91	161.77
470	18° 48′	44° 10.8′	230.42	29.57	442.81	115.77	457.70	323.68	166.12
480	19° 12′	46° 04.8′	234.92	31.44	449.87	122.86	466.34	331.56	170.56
490	19° 36′	48° 01.2′	239.37	33.38	456.68	130.17	474.87	339.56	175.11
500	20° 00′	50° 00.0′	243.79	35.39	463.24	137.72	483.28	347.68	179.78

THE STANDARD HIGHWAY SPIRAL

a = 4.5

L	D	S	q	p	Y	X	C	U	V
10	0° 27′	0° 01.4′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0° 54′	0° 05.4′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1° 21′	0° 12.2′	15.00	0.01	30.00	0.03	30.00	20.00	10.00
40	1° 48′	0° 21.6′	20.00	0.02	40.00	0.08	40.00	26.67	13.33
50	2° 15′	0° 33.8′	25.00	0.04	50.00	0.16	50.00	33.33	16.67
60	2° 42′	0° 48.6′	30.00	0.07	60.00	0.28	60.00	40.00	20.00
70	3° 09′	1° 06.2′	35.00	0.11	70.00	0.45	70.00	46.67	23.33
80	3° 36′	1° 26.4′	40.00	0.17	79.99	0.67	80.00	53.34	26.67
90	4° 03′	1° 49.4′	45.00	0.24	89.99	0.95	90.00	60.00	30.00
100	4° 30′	2° 15.0′	50.00	0.33	99.98	1.31	99.99	66.67	33.34
110	4° 57′	2° 43.4′	55.00	0.44	109.98	1.74	109.99	73.34	36.67
120	5° 24′	3° 14.4′	59.99	0.57	119.96	2.26	119.98	80.01	40.01
130	5° 51′	3° 48.2′	64.99	0.72	129.94	2.87	129.97	86.69	43.35
140	6° 18′	4° 24.6′	69.99	0.90	139.92	3.59	139.96	93.36	46.69
150	6° 45′	5° 03.8′	74.98	1.10	149.88	4.42	149.95	100.04	50.04
160	7° 12′	5° 45.6′	79.97	1.34	159.84	5.36	159.93	106.72	53.39
170	7° 39′	6° 30.2′	84.96	1.61	169.78	6.43	169.90	113.41	56.74
180	8° 06′	7° 17.4′	89.95	1.91	179.71	7.63	179.87	120.10	60.09
190	8° 33′	8° 07.4′	94.94	2.24	189.62	8.97	189.83	126.80	63.45
200	9° 00′	9° 00.0′	99.92	2.62	199.51	10.45	199.78	133.51	66.82
210	9° 27′	9° 55.4′	104.90	3.03	209.37	12.09	209.72	140.22	70.20
220	9° 54′	10° 53.4′	109.87	3.48	219.21	13.90	219.65	146.95	73.59
230	10° 21′	11° 54.2′	114.83	3.98	229.01	15.88	229.56	153.68	76.98
240	10° 48′	12° 57.6′	119.80	4.52	238.77	18.03	239.45	160.43	80.39
250	11° 15′	14° 03.8′	124.75	5.10	248.49	20.37	249.33	167.20	83.81
260	11° 42′	15° 12.6′	129.70	5.74	258.17	22.89	259.19	173.98	87.25
270	12° 09′	16° 24.2′	134.63	6.42	267.80	25.61	269.02	180.78	90.71
280	12° 36′	17° 38.4′	139.56	7.16	277.36	28.54	278.82	187.60	94.18
290	13° 03′	18° 55.4′	144.47	7.95	286.85	31.68	288.60	194.45	97.68
300	13° 30′	20° 15.0′	149.38	8.80	296.27	35.03	298.34	201.32	101.21
310	13° 57′	21° 37.4′	154.27	9.70	305.61	38.60	308.04	208.23	104.76
320	14° 24′	23° 02.4′	159.14	10.66	314.86	42.40	317.71	215.17	108.34
330	14° 51′	24° 30.2′	164.00	11.68	324.02	46.43	327.33	222.14	111.95
340	15° 18′	26° 00.6′	168.84	12.77	333.06	50.70	336.90	229.16	115.61
350	15° 45′	27° 33.8′	173.66	13.92	341.99	55.20	346.41	236.23	119.30
360	16° 12′	29° 09.6′	178.46	15.13	350.79	59.95	355.87	243.34	123.04
370	16° 39′	30° 48.2′	183.23	16.41	359.45	64.95	365.27	250.51	126.83
380	17° 06′	32° 29.4′	187.98	17.75	367.96	70.19	374.60	257.74	130.68
390	17° 33′	34° 13.4′	192.70	19.17	376.31	75.69	383.85	265.03	134.59
400	18° 00′	36° 00.0′	197.40	20.65	384.49	81.44	393.02	272.40	138.56
410	18° 27′	37° 49.4′	202.06	22.21	392.49	87.45	402.11	279.85	142.61
420	18° 54′	39° 41.4′	206.69	23.83	400.29	93.71	411.11	287.38	146.73
430	19° 21′	41° 36.2′	211.28	25.53	407.88	100.22	420.01	295.01	150.94
440	19° 48′	43° 33.6′	215.83	27.31	415.24	106.99	428.80	302.74	155.25
450	20° 15′	45° 33.8′	220.34	29.16	422.36	114.00	437.48	310.53	159.66
460	20° 42′	47° 36.6′	224.81	31.08	429.24	121.26	446.04	318.55	164.19

THE STANDARD HIGHWAY SPIRAL

a = 5.0

L	D	S	q	p	Y	X	C	U	V
10	0° 30′	0° 01.5′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 00′	0° 06.0′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1° 30′	0° 13.5′	15.00	0.01	30.00	0.04	30.00	20.00	10.00
40	2° 00′	0° 24.0′	20.00	0.02	40.00	0.09	40.00	26.67	13.33
50	2° 30′	0° 37.5′	25.00	0.05	50.00	0.18	50.00	33.33	16.67
60	3° 00′	0° 54.0′	30.00	0.08	60.00	0.31	60.00	40.00	20.00
70	3° 30′	1° 13.5′	35.00	0.12	70.00	0.50	70.00	46.67	23.33
80	4° 00′	1° 36.0′	40.00	0.19	79.99	0.74	80.00	53.34	26.67
90	4° 30′	2° 01.5′	45.00	0.27	89.99	1.06	89.99	60.00	30.00
100	5° 00′	2° 30.0′	50.00	0.36	99.98	1.45	99.99	66.67	33.34
110	5° 30′	3° 01.5′	55.00	0.48	109.97	1.93	109.99	73.34	36.68
120	6° 00′	3° 36.0′	59.99	0.63	119.95	2.51	119.98	80.02	40.02
130	6° 30′	4° 13.5′	64.99	0.80	129.93	3.19	129.97	86.69	43.36
140	7° 00′	4° 54.0′	69.98	1.00	139.90	3.99	139.95	93.37	46.70
150	7° 30′	5° 37.5′	74.98	1.23	149.86	4.91	149.94	100.05	50.05
160	8° 00′	6° 24.0′	79.97	1.49	159.80	5.95	159.91	106.74	53.40
170	8° 30′	7° 13.5′	84.96	1.79	169.73	7.14	169.88	113.43	56.75
180	9° 00′	8° 06.0′	89.94	2.12	179.64	8.47	179.84	120.13	60.11
190	9° 30′	9° 01.5′	94.92	2.49	189.53	9.96	189.79	126.83	63.48
200	10° 00′	10° 00.0′	99.90	2.90	199.39	11.61	199.73	133.55	66.86
210	10° 30′	11° 01.5′	104.88	3.36	209.22	13.43	209.65	140.27	70.25
220	11° 00′	12° 06.0′	109.84	3.87	219.02	15.44	219.56	147.01	73.65
230	11° 30′	13° 13.5′	114.80	4.42	228.78	17.63	229.46	153.76	77.06
240	12° 00′	14° 24.0′	119.75	5.02	238.49	20.02	239.33	160.53	80.48
250	12° 30′	15° 37.5′	124.69	5.67	248.15	22.61	249.18	167.32	83.93
260	13° 00′	16° 54.0′	129.62	6.37	257.75	25.40	259.00	174.13	87.39
270	13° 30′	18° 13.5′	134.55	7.13	267.28	28.42	268.79	180.96	90.88
280	14° 00′	19° 36.0′	139.46	7.95	276.74	31.66	278.55	187.82	94.39
290	14° 30′	21° 01.5′	144.35	8.83	286.12	35.13	288.27	194.71	97.92
300	15° 00′	22° 30.0′	149.23	9.76	295.41	38.84	297.95	201.64	101.49
310	15° 30′	24° 01.5′	154.10	10.76	304.59	42.79	307.58	208.60	105.10
320	16° 00′	25° 36.0′	158.94	11.83	313.67	46.98	317.17	215.61	108.74
330	16° 30′	27° 13.5′	163.77	12.96	322.63	51.43	326.70	222.66	112.42
340	17° 00′	28° 54.0′	168.57	14.16	331.45	56.13	336.17	229.76	116.15
350	17° 30′	30° 37.5′	173.35	15.43	340.13	61.10	345.58	236.92	119.94
360	18° 00′	32° 24.0′	178.10	16.77	348.66	66.33	354.91	244.15	123.78
370	18° 30′	34° 13.5′	182.82	18.19	357.02	71.82	364.17	251.44	127.68
380	19° 00′	36° 06.0′	187.51	19.67	365.19	77.57	373.34	258.81	131.66
390	19° 30′	38° 01.5′	192.17	21.23	373.17	83.60	382.42	266.26	135.71
400	20° 00′	40° 00.0′	196.79	22.87	380.94	89.89	391.40	273.81	139.85
410	20° 30′	42° 01.5′	201.38	24.58	388.49	96.45	400.28	281.46	144.08
420	21° 00′	44° 06.0′	205.92	26.38	395.79	103.28	409.05	289.21	148.41
430	21° 30′	46° 13.5′	210.42	28.25	402.84	110.37	417.69	297.09	152.85
440	22° 00′	48° 24.0′	214.87	30.20	409.62	117.72	426.20	305.10	157.42
450	22° 30′	50° 37.5′	219.27	32.23	416.12	125.33	434.58	313.26	162.13

THE STANDARD HIGHWAY SPIRAL

a = 5.5

L	D	S	q	p	Y	X	C	U	V
10	0° 33′	0° 01.7′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 06′	0° 06.6′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1° 39′	0° 14.9′	15.00	0.01	30.00	0.04	30.00	20.00	10.00
40	2° 12′	0° 26.4′	20.00	0.03	40.00	0.10	40.00	26.67	13.33
50	2° 45′	0° 41.3′	25.00	0.05	50.00	0.20	50.00	33.33	16.67
60	3° 18′	0° 59.4′	30.00	0.09	60.00	0.35	60.00	40.00	20.00
70	3° 51′	1° 20.9′	35.00	0.14	70.00	0.55	70.00	46.67	23.33
80	4° 24′	1° 45.6′	40.00	0.20	79.99	0.82	80.00	53.34	26.67
90	4° 57′	2° 13.7′	45.00	0.29	89.99	1.17	89.99	60.00	30.00
100	5° 30′	2° 45.0′	50.00	0.40	99.98	1.60	99.99	66.67	33.34
110	6° 03′	3° 19.7′	54.99	0.53	109.96	2.13	109.98	73.35	36.68
120	6° 36′	3° 57.6′	59.99	0.69	119.94	2.76	119.97	80.02	40.02
130	7° 09′	4° 38.9′	64.99	0.88	129.91	3.51	129.96	86.70	43.36
140	7° 42′	5° 23.4′	69.98	1.10	139.88	4.39	139.95	93.38	46.71
150	8° 15′	6° 11.3′	74.97	1.35	149.83	5.40	149.92	100.06	50.06
160	8° 48′	7° 02.4′	79.96	1.64	159.76	6.55	159.89	106.75	53.41
170	9° 21′	7° 56.9′	84.95	1.96	169.67	7.85	169.86	113.45	56.77
180	9° 54′	8° 54.6′	89.93	2.33	179.57	9.31	179.81	120.15	60.14
190	10° 27′	9° 55.7′	94.91	2.74	189.43	10.95	189.75	126.87	63.51
200	11° 00′	11° 00.0′	99.88	3.20	199.26	12.77	199.67	133.59	66.90
210	11° 33′	12° 07.7′	104.84	3.70	209.06	14.77	209.58	140.33	70.30
220	12° 06′	13° 18.6′	109.80	4.25	218.82	16.97	219.47	147.08	73.71
230	12° 39′	14° 32.9′	114.75	4.86	228.52	19.38	229.34	153.85	77.14
240	13° 12′	15° 50.4′	119.70	5.52	238.17	22.00	239.19	160.65	80.59
250	13° 45′	17° 11.3′	124.63	6.23	247.76	24.84	249.01	167.46	84.06
260	14° 18′	18° 35.4′	129.55	7.00	257.28	27.91	258.79	174.30	87.55
270	14° 51′	20° 02.9′	134.45	7.84	266.71	31.22	268.53	181.17	91.06
280	15° 24′	21° 33.6′	139.34	8.74	276.06	34.77	278.24	188.07	94.61
290	15° 57′	23° 07.7′	144.22	9.70	285.31	38.57	287.91	195.01	98.19
300	16° 30′	24° 45.0′	149.07	10.73	294.45	42.62	297.52	201.99	101.81
310	17° 03′	26° 25.7′	153.91	11.83	303.47	46.94	307.08	209.02	105.47
320	17° 36′	28° 09.6′	158.72	12.99	312.36	51.53	316.58	216.10	109.18
330	18° 09′	29° 56.9′	163.51	14.23	321.10	56.38	326.01	223.23	112.94
340	18° 42′	31° 47.4′	168.27	15.55	329.68	61.51	335.37	230.43	116.76
350	19° 15′	33° 41.3′	173.00	16.94	338.09	66.92	344.65	237.70	120.65
360	19° 48′	35° 38.4′	177.70	18.41	346.32	72.61	353.85	245.05	124.61
370	20° 21′	37° 38.9′	182.37	19.95	354.34	78.57	362.95	252.49	128.64
380	20° 54′	39° 42.6′	187.00	21.57	362.15	84.82	371.95	260.02	132.76
390	21° 27′	41° 49.7′	191.59	23.28	369.72	91.35	380.84	267.65	136.98
400	22° 00′	44° 00.0′	196.13	25.07	377.04	98.16	389.61	275.40	141.31
410	22° 33′	46° 13.7′	200.63	26.93	384.10	105.24	398.26	283.27	145.75
420	23° 06′	48° 30.6′	205.08	28.89	390.88	112.60	406.77	291.29	150.32

THE STANDARD HIGHWAY SPIRAL

a = 6.0

L	D	S	q	p	Y	X	C	U	V
10	0° 36′	0° 01.8′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 12′	0° 07.2′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1° 48′	0° 16.2′	15.00	0.01	30.00	0.05	30.00	20.00	10.00
40	2° 24′	0° 28.8′	20.00	0.03	40.00	0.11	40.00	26.67	13.33
50	3° 00′	0° 45.0′	25.00	0.05	50.00	0.22	50.00	33.33	16.67
60	3° 36′	1° 04.8′	30.00	0.09	60.00	0.38	60.00	40.00	20.00
70	4° 12′	1° 28.2′	35.00	0.15	70.00	0.60	70.00	46.67	23.33
80	4° 48′	1° 55.2′	40.00	0.22	79.99	0.89	80.00	53.34	26.67
90	5° 24′	2° 25.8′	45.00	0.32	89.98	1.27	89.99	60.01	30.01
100	6° 00′	3° 00.0′	50.00	0.44	99.97	1.74	99.99	66.68	33.34
110	6° 36′	3° 37.8′	54.99	0.58	109.96	2.32	109.98	73.35	36.68
120	7° 12′	4° 19.2′	59.99	0.76	119.93	3.02	119.97	80.02	40.02
130	7° 48′	5° 04.2′	64.98	0.96	129.90	3.84	129.96	86.70	43.37
140	8° 24′	5° 52.8′	69.98	1.20	139.85	4.79	139.93	93.39	46.71
150	9° 00′	6° 45.0′	74.97	1.47	149.79	5.88	149.91	100.07	50.07
160	9° 36′	7° 40.8′	79.95	1.79	159.71	7.14	159.87	106.77	53.43
170	10° 12′	8° 40.2′	84.94	2.14	169.61	8.56	169.83	113.47	56.79
180	10° 48′	9° 43.2′	89.91	2.54	179.48	10.16	179.77	120.18	60.16
190	11° 24′	10° 49.8′	94.89	2.99	189.32	11.94	189.70	126.90	63.55
200	12° 00′	12° 00.0′	99.85	3.49	199.12	13.92	199.61	133.64	66.95
210	12° 36′	13° 13.8′	104.81	4.04	208.88	16.10	209.50	140.39	70.36
220	13° 12′	14° 31.2′	109.76	4.64	218.59	18.50	219.37	147.16	73.78
230	13° 48′	15° 52.2′	114.71	5.29	228.24	21.12	229.22	153.95	77.23
240	14° 24′	17° 16.8′	119.64	6.01	237.83	23.97	239.03	160.77	80.70
250	15° 00′	18° 45.0′	124.56	6.79	247.34	27.06	248.81	167.61	84.19
260	15° 36′	20° 16.8′	129.46	7.63	256.76	30.40	258.56	174.48	87.71
270	16° 12′	21° 52.2′	134.35	8.54	266.09	34.00	268.26	181.39	91.27
280	16° 48′	23° 31.2′	139.22	9.52	275.32	37.85	277.91	188.34	94.86
290	17° 24′	25° 13.8′	144.07	10.57	284.43	41.98	287.51	195.33	98.49
300	18° 00′	27° 00.0′	148.90	11.69	293.41	46.38	297.05	202.38	102.16
310	18° 36′	28° 49.8′	153.70	12.88	302.24	51.06	306.53	209.48	105.89
320	19° 12′	30° 43.2′	158.48	14.15	310.92	56.03	315.93	216.64	109.67
330	19° 48′	32° 40.2′	163.23	15.50	319.43	61.28	325.26	223.87	113.52
340	20° 24′	34° 40.8′	167.95	16.93	327.75	66.82	334.50	231.17	117.44
350	21° 00′	36° 45.0′	172.63	18.44	335.87	72.66	343.64	238.57	121.44
360	21° 36′	38° 52.8′	177.27	20.03	343.77	78.79	352.68	246.06	125.52
370	22° 12′	41° 04.2′	181.88	21.70	351.43	85.21	361.62	253.65	129.70
380	22° 48′	43° 19.2′	186.44	23.46	358.84	91.93	370.43	261.36	133.99
390	23° 24′	45° 37.8′	190.95	25.30	365.98	98.93	379.12	269.20	138.40
400	24° 00′	48° 00.0′	195.41	27.24	372.82	106.22	387.66	277.18	142.94

THE STANDARD HIGHWAY SPIRAL

a = 6.5

L	D	S	q	p	Y	X	C	U	V
10	0° 39′	0° 02.0′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 18′	0° 07.8′	10.00	0.00	20.00	0.02	20.00	13.33	6.67
30	1° 57′	0° 17.6′	15.00	0.01	30.00	0.05	30.00	20.00	10.00
40	2° 36′	0° 31.2′	20.00	0.03	40.00	0.12	40.00	26.67	13.33
50	3° 15′	0° 48.8′	25.00	0.06	50.00	0.24	50.00	33.33	16.67
60	3° 54′	1° 10.2′	30.00	0.10	60.00	0.41	60.00	40.00	20.00
70	4° 33′	1° 35.6′	35.00	0.16	69.99	0.65	70.00	46.67	23.34
80	5° 12′	2° 04.8′	40.00	0.24	79.99	0.97	80.00	53.34	26.67
90	5° 51′	2° 38.0′	45.00	0.34	89.98	1.38	89.99	60.01	30.01
100	6° 30′	3° 15.0′	49.99	0.47	99.97	1.89	99.99	66.68	33.34
110	7° 09′	3° 56.0′	54.99	0.63	109.95	2.52	109.98	73.35	36.68
120	7° 48′	4° 40.8′	59.99	0.82	119.92	3.27	119.96	80.03	40.03
130	8° 27′	5° 29.6′	64.98	1.04	129.88	4.15	129.95	86.71	43.37
140	9° 06′	6° 22.2′	69.97	1.30	139.83	5.18	139.92	93.39	46.72
150	9° 45′	7° 18.8′	74.96	1.59	149.76	6.37	149.89	100.09	50.08
160	10° 24′	8° 19.2′	79.94	1.93	159.66	7.73	159.85	106.79	53.44
170	11° 03′	9° 23.6′	84.92	2.32	169.54	9.27	169.80	113.49	56.81
180	11° 42′	10° 31.8′	89.90	2.75	179.39	11.00	179.73	120.21	60.19
190	12° 21′	11° 44.0′	94.87	3.24	189.20	12.93	189.65	126.94	63.59
200	13° 00′	13° 00.0′	99.83	3.78	198.97	15.07	199.54	133.69	67.00
210	13° 39′	14° 20.0′	104.78	4.37	208.69	17.43	209.41	140.46	70.42
220	14° 18′	15° 43.8′	109.72	5.02	218.35	20.02	219.26	147.25	73.86
230	14° 57′	17° 11.6′	114.65	5.73	227.94	22.86	229.08	154.06	77.33
240	15° 36′	18° 43.2′	119.57	6.51	237.45	25.94	238.86	160.90	80.82
250	16° 15′	20° 18.8′	124.48	7.35	246.88	29.28	248.60	167.78	84.34
260	16° 54′	21° 58.2′	129.37	8.26	256.21	32.88	258.30	174.69	87.90
270	17° 33′	23° 41.6′	134.23	9.25	265.42	36.76	267.95	181.64	91.49
280	18° 12′	25° 28.8′	139.08	10.31	274.51	40.92	277.55	188.64	95.13
290	18° 51′	27° 20.0′	143.91	11.44	283.47	45.37	287.08	195.69	98.81
300	19° 30′	29° 15.0′	148.71	12.64	292.28	50.11	296.54	202.80	102.55
310	20° 09′	31° 14.0′	153.48	13.93	300.91	55.14	305.93	209.98	106.35
320	20° 48′	33° 16.3′	158.22	15.30	309.37	60.48	315.23	217.23	110.22
330	21° 27′	35° 23.6′	162.92	16.76	317.63	66.12	324.44	224.56	114.16
340	22° 06′	37° 34.2′	167.59	18.30	325.67	72.06	333.55	231.99	118.19
350	22° 45′	39° 48.8′	172.22	19.92	333.48	78.31	342.55	239.52	122.31
360	23° 24′	42° 07.2′	176.81	21.63	341.03	84.87	351.43	247.17	126.54
370	24° 03′	44° 29.6′	181.34	23.43	348.30	91.73	360.18	254.94	130.89
380	24° 42′	46° 55.8′	185.83	25.32	355.28	98.88	368.79	262.85	135.36
390	25° 21′	49° 26.0′	190.26	27.31	361.95	106.33	377.25	270.92	139.98
400	26° 00′	52° 00.0′	194.64	29.40	368.31	114.08	385.55	279.17	144.75

THE STANDARD HIGHWAY SPIRAL

$a = 7.0$

L	D	S	q	p	Y	X	C	U	V
10	0° 42′	0° 02.1′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 24′	0° 08.4′	10.00	0.00	20.00	0.02	20.00	13.33	6.67
30	2° 06′	0° 18.9′	15.00	0.01	30.00	0.05	30.00	20.00	10.00
40	2° 48′	0° 33.6′	20.00	0.03	40.00	0.13	40.00	26.67	13.33
50	3° 30′	0° 52.5′	25.00	0.06	50.00	0.25	50.00	33.33	16.67
60	4° 12′	1° 15.6′	30.00	0.11	60.00	0.44	60.00	40.00	20.00
70	4° 54′	1° 42.9′	35.00	0.17	69.99	0.70	70.00	46.67	23.34
80	5° 36′	2° 14.4′	40.00	0.26	79.99	1.04	79.99	53.34	26.67
90	6° 18′	2° 50.1′	45.00	0.37	89.98	1.48	89.99	60.01	30.01
100	7° 00′	3° 30.0′	49.99	0.51	99.96	2.04	99.98	66.68	33.35
110	7° 42′	4° 14.1′	54.99	0.68	109.94	2.71	109.97	73.35	36.69
120	8° 24′	5° 02.4′	59.98	0.88	119.91	3.52	119.96	80.03	40.03
130	9° 06′	5° 54.9′	64.98	1.12	129.86	4.47	129.94	86.72	43.38
140	9° 48′	6° 51.6′	69.97	1.40	139.80	5.58	139.91	93.40	46.73
150	10° 30′	7° 52.5′	74.95	1.72	149.72	6.86	149.87	100.10	50.09
160	11° 12′	8° 57.6′	79.93	2.08	159.61	8.33	159.82	106.80	53.46
170	11° 54′	10° 06.9′	84.91	2.50	169.47	9.98	169.76	113.52	56.84
180	12° 36′	11° 20.4′	89.88	2.97	179.30	11.84	179.69	120.25	60.22
190	13° 18′	12° 38.1′	94.85	3.49	189.08	13.92	189.59	126.99	63.63
200	14° 00′	14° 00.0′	99.80	4.06	198.81	16.22	199.47	133.75	67.05
210	14° 42′	15° 26.1′	104.75	4.70	208.48	18.76	209.33	140.53	70.49
220	15° 24′	16° 56.4′	109.68	5.40	218.08	21.55	219.15	147.34	73.95
230	16° 06′	18° 30.9′	114.60	6.17	227.61	24.59	228.93	154.18	77.44
240	16° 48′	20° 09.6′	119.51	7.01	237.05	27.90	238.68	161.05	80.96
250	17° 30′	21° 52.5′	124.40	7.91	246.38	31.49	248.38	167.96	84.51
260	18° 12′	23° 39.6′	129.26	8.89	255.60	35.35	258.03	174.91	88.10
270	18° 54′	25° 30.9′	134.11	9.95	264.69	39.51	267.63	181.91	91.74
280	19° 36′	27° 26.4′	138.94	11.08	273.64	43.97	277.16	188.96	95.42
290	20° 18′	29° 26.1′	143.73	12.30	282.44	48.73	286.61	196.08	99.16
300	21° 00′	31° 30.0′	148.50	13.60	291.06	53.80	295.99	203.26	102.97
310	21° 42′	33° 38.1′	153.24	14.98	299.49	59.18	305.28	210.52	106.85
320	22° 24′	35° 50.4′	157.94	16.45	307.70	64.88	314.47	217.88	110.81
330	23° 06′	38° 06.9′	162.60	18.01	315.69	70.89	323.56	225.33	114.86
340	23° 48′	40° 27.6′	167.21	19.65	323.43	77.23	332.53	232.89	119.01
350	24° 30′	42° 52.5′	171.78	21.39	330.90	83.87	341.37	240.57	123.27
360	25° 12′	45° 21.6′	176.30	23.23	338.08	90.83	350.07	248.38	127.66

THE STANDARD HIGHWAY SPIRAL

a = 8.0

L	D	S	q	p	Y	X	C	U	V
10	0° 48′	0° 02.4′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 36′	0° 09.6′	10.00	0.00	20.00	0.02	20.00	13.33	6.67
30	2° 24′	0° 21.6′	15.00	0.02	30.00	0.06	30.00	20.00	10.00
40	3° 12′	0° 38.4′	20.00	0.04	40.00	0.15	40.00	26.67	13.33
50	4° 00′	1° 00.0′	25.00	0.07	50.00	0.29	50.00	33.33	16.67
60	4° 48′	1° 26.4′	30.00	0.13	60.00	0.50	60.00	40.00	20.00
70	5° 36′	1° 57.6′	35.00	0.20	69.99	0.80	70.00	46.67	23.34
80	6° 24′	2° 33.6′	40.00	0.30	79.98	1.19	79.99	53.34	26.67
90	7° 12′	3° 14.4′	45.00	0.42	89.97	1.70	89.99	60.01	30.01
100	8° 00′	4° 00.0′	49.99	0.58	99.95	2.33	99.98	66.68	33.35
110	8° 48′	4° 50.4′	54.99	0.77	109.92	3.10	109.97	73.36	36.69
120	9° 36′	5° 45.6′	59.98	1.00	119.88	4.02	119.95	80.04	40.04
130	10° 24′	6° 45.6′	64.97	1.28	129.82	5.11	129.92	86.73	43.39
140	11° 12′	7° 50.4′	69.96	1.60	139.74	6.38	139.88	93.43	46.75
150	12° 00′	9° 00.0′	74.94	1.96	149.63	7.84	149.83	100.13	50.12
160	12° 48′	10° 14.4′	79.91	2.38	159.49	9.51	159.77	106.85	53.50
170	13° 36′	11° 33.6′	84.88	2.85	169.31	11.40	169.69	113.58	56.89
180	14° 24′	12° 57.6′	89.85	3.39	179.08	13.52	179.59	120.32	60.29
190	15° 12′	14° 26.4′	94.80	3.98	188.80	15.89	189.46	127.09	63.72
200	16° 00′	16° 00.0′	99.74	4.64	198.45	18.52	199.31	133.88	67.17
210	16° 48′	17° 38.4′	104.67	5.37	208.02	21.41	209.12	140.70	70.64
220	17° 36′	19° 21.6′	109.58	6.17	217.50	24.58	218.89	147.55	74.14
230	18° 24′	21° 09.6′	114.48	7.04	226.88	28.04	228.61	154.44	77.68
240	19° 12′	23° 02.4′	119.36	8.00	236.15	31.80	238.28	161.38	81.25
250	20° 00′	25° 00.0′	124.21	9.03	245.29	35.87	247.89	168.36	84.87
260	20° 48′	27° 02.4′	129.04	10.14	254.27	40.25	257.44	175.40	88.55
270	21° 36′	29° 09.6′	133.84	11.35	263.09	44.96	266.91	182.50	92.28
280	22° 24′	31° 21.6′	138.61	12.64	271.73	50.00	276.29	189.68	96.08
290	23° 12′	33° 38.4′	143.35	14.02	280.16	55.37	285.58	196.94	99.96
300	24° 00′	36° 00.0′	148.04	15.49	288.37	61.08	294.77	204.30	103.92
310	24° 48′	38° 26.4′	152.70	17.06	296.33	67.13	303.84	211.76	107.98
320	25° 36′	40° 57.6′	157.31	18.72	304.03	73.52	312.79	219.34	112.15
330	26° 24′	43° 33.6′	161.87	20.48	311.43	80.24	321.60	227.05	116.44
340	27° 12′	46° 14.4′	166.38	22.34	318.51	87.29	330.25	234.92	120.87
350	28° 00′	49° 00.0′	170.82	24.30	325.25	94.68	338.75	242.95	125.45

THE STANDARD HIGHWAY SPIRAL

a = 9.0

L	D	S	q	p	Y	X	C	U	V
10	0° 54′	0° 02.7′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1° 48′	0° 10.8′	10.00	0.01	20.00	0.02	20.00	13.33	6.67
30	2° 42′	0° 24.3′	15.00	0.02	30.00	0.07	30.00	20.00	10.00
40	3° 36′	0° 43.2′	20.00	0.04	40.00	0.17	40.00	26.67	13.33
50	4° 30′	1° 07.5′	25.00	0.08	50.00	0.33	50.00	33.33	16.67
60	5° 24′	1° 37.2′	30.00	0.14	60.00	0.57	60.00	40.00	20.00
70	6° 18′	2° 12.3′	35.00	0.22	69.99	0.90	70.00	46.67	23.34
80	7° 12′	2° 52.8′	40.00	0.34	79.98	1.34	79.99	53.34	26.67
90	8° 06′	3° 38.7′	44.99	0.48	89.96	1.91	89.98	60.01	30.01
100	9° 00′	4° 30.0′	49.99	0.65	99.94	2.62	99.97	66.69	33.35
110	9° 54′	5° 26.7′	54.98	0.87	109.80	3.48	109.96	73.37	36.70
120	10° 48′	6° 28.8′	59.98	1.13	119.85	4.52	119.93	80.05	40.05
130	11° 42′	7° 36.3′	64.96	1.43	129.77	5.74	129.90	86.75	43.41
140	12° 36′	8° 49.2′	69.94	1.79	139.67	7.17	139.85	93.45	46.77
150	13° 30′	10° 07.5′	74.92	2.21	149.53	8.82	149.79	100.16	50.15
160	14° 24′	11° 31.2′	79.89	2.68	159.35	10.69	159.71	106.89	53.54
170	15° 18′	13° 00.3′	84.85	3.21	169.13	12.81	169.61	113.64	56.95
180	16° 12′	14° 34.8′	89.81	3.81	178.84	15.20	179.48	120.41	60.37
190	17° 06′	16° 14.7′	94.75	4.48	188.48	17.86	189.32	127.20	63.82
200	18° 00′	18° 00.0′	99.67	5.22	198.04	20.80	199.12	134.03	67.30
210	18° 54′	19° 50.7′	104.58	6.04	207.49	24.04	208.88	140.89	70.81
220	19° 48′	21° 46.8′	109.47	6.93	216.84	27.59	218.59	147.79	74.36
230	20° 42′	23° 48.3′	114.34	7.91	226.06	31.46	228.24	154.74	77.95
240	21° 36′	25° 55.2′	119.19	8.98	235.13	35.67	237.82	161.75	81.59
250	22° 30′	28° 07.5′	124.00	10.14	244.04	40.21	247.33	168.82	85.29
260	23° 24′	30° 25.2′	128.79	11.39	252.77	45.10	256.76	175.96	89.06
270	24° 18′	32° 48.3′	133.54	12.73	261.28	50.34	266.09	183.19	92.91
280	25° 12′	35° 16.8′	138.25	14.17	269.57	55.93	275.31	190.51	96.84
290	26° 06′	37° 50.7′	142.92	15.72	277.60	61.89	284.42	197.94	100.87
300	27° 00′	40° 30.0′	147.54	17.36	285.35	68.20	293.39	205.50	105.02
310	27° 54′	43° 14.7′	152.10	19.11	292.80	74.88	302.22	213.19	109.29
320	28° 48′	46° 04.8′	156.61	20.96	299.91	81.91	310.90	221.04	113.71

THE STANDARD HIGHWAY SPIRAL

$a = 10.0$

L	D	S	q	p	Y	X	C	U	V
10	1°	0° 03′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	2°	0° 12′	10.00	0.01	20.00	0.02	20.00	13.33	6.67
30	3°	0° 27′	15.00	0.02	30.00	0.08	30.00	20.00	10.00
40	4°	0° 48′	20.00	0.05	40.00	0.19	40.00	26.67	13.33
50	5°	1° 15′	25.00	0.09	50.00	0.36	50.00	33.33	16.67
60	6°	1° 48′	30.00	0.16	59.99	0.63	60.00	40.00	20.00
70	7°	2° 27′	35.00	0.25	69.99	1.00	69.99	46.67	23.34
80	8°	3° 12′	40.00	0.37	79.98	1.49	79.99	53.34	26.67
90	9°	4° 03′	44.99	0.53	89.96	2.12	89.98	60.02	30.01
100	10°	5° 00′	49.99	0.73	99.92	2.91	99.97	66.69	33.36
110	11°	6° 03′	54.98	0.97	109.88	3.87	109.95	73.38	36.71
120	12°	7° 12′	59.97	1.26	119.81	5.02	119.92	80.07	40.06
130	13°	8° 27′	64.95	1.60	129.72	6.38	129.88	86.77	43.42
140	14°	9° 48′	69.93	1.99	139.59	7.97	139.82	93.48	46.80
150	15°	11° 15′	74.90	2.45	149.42	9.79	149.75	100.20	50.19
160	16°	12° 48′	79.87	2.97	159.20	11.87	159.65	106.95	53.59
170	17°	14° 27′	84.82	3.56	168.92	14.23	169.52	113.72	57.01
180	18°	16° 12′	89.76	4.23	178.56	16.87	179.36	120.51	60.46
190	19°	18° 03′	94.69	4.97	188.12	19.81	189.16	127.33	63.94
200	20°	20° 00′	99.60	5.79	197.58	23.07	198.92	134.19	67.45
210	21°	22° 03′	104.48	6.70	206.91	26.66	208.62	141.10	71.00
220	22°	24° 12′	109.35	7.69	216.11	30.59	218.26	148.06	74.60
230	23°	26° 27′	114.19	8.78	225.15	34.86	227.83	155.08	78.26
240	24°	28° 48′	119.00	9.96	234.01	39.49	237.32	162.17	81.98
250	25°	31° 15′	123.77	11.24	242.67	44.49	246.71	169.34	85.77
260	26°	33° 48′	128.51	12.62	251.10	49.87	256.00	176.60	89.65
270	27°	36° 27′	133.20	14.11	259.28	55.62	265.17	183.97	93.62
280	28°	39° 12′	137.84	15.70	267.17	61.75	274.22	191.46	97.70
290	29°	42° 03′	142.43	17.39	274.76	68.26	283.12	199.09	101.92
300	30°	45° 00′	146.97	19.21	282.02	75.15	291.86	206.87	106.28

THE STANDARD HIGHWAY SPIRAL

a = 12.5

L	D	S	q	p	Y	X	C	U	V
10	1° 15′	0° 03.8′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	2° 30′	0° 15.0′	10.00	0.01	20.00	0.03	20.00	13.33	6.67
30	3° 45′	0° 33.8′	15.00	0.02	30.00	0.10	30.00	20.00	10.00
40	5° 00′	1° 00.0′	20.00	0.06	40.00	0.23	40.00	26.67	13.33
50	6° 15′	1° 33.8′	25.00	0.11	50.00	0.45	50.00	33.33	16.67
60	7° 30′	2° 15.0′	30.00	0.20	59.99	0.79	60.00	40.00	20.00
70	8° 45′	3° 03.8′	35.00	0.31	69.98	1.25	69.99	46.67	23.34
80	10° 00′	4° 00.0′	39.99	0.47	79.96	1.86	79.98	53.35	26.68
90	11° 15′	5° 03.8′	44.99	0.66	89.93	2.65	89.97	60.02	30.02
100	12° 30′	6° 15.0′	49.98	0.91	99.88	3.63	99.95	66.71	33.37
110	13° 45′	7° 33.8′	54.97	1.21	109.81	4.83	109.92	73.40	36.73
120	15° 00′	9° 00.0′	59.95	1.57	119.70	6.27	119.87	80.10	40.09
130	16° 15′	10° 33.8′	64.93	1.99	129.56	7.97	129.80	86.82	43.47
140	17° 30′	12° 15.0′	69.89	2.49	139.36	9.94	139.71	93.56	46.87
150	18° 45′	14° 03.8′	74.85	3.06	149.10	12.22	149.60	100.32	50.29
160	20° 00′	16° 00.0′	79.79	3.71	158.76	14.81	159.45	107.11	53.73
170	21° 15′	18° 03.8′	84.72	4.45	168.32	17.74	169.25	113.93	57.21
180	22° 30′	20° 15.0′	89.63	5.28	177.76	21.02	179.00	120.79	60.72
190	23° 45′	22° 33.8′	94.51	6.20	187.07	24.67	188.69	127.71	64.28
200	25° 00′	25° 00.0′	99.37	7.22	196.23	28.70	198.31	134.69	67.90
210	26° 15′	27° 33.8′	104.20	8.35	205.19	33.12	207.85	141.74	71.58
220	27° 30′	30° 15.0′	108.99	9.58	213.95	37.95	217.29	148.87	75.34
230	28° 45′	33° 03.8′	113.74	10.93	222.46	43.20	226.62	156.10	79.19
240	30° 00′	36° 00.0′	118.44	12.39	230.70	48.87	235.82	163.44	83.14
250	31° 15′	39° 03.8′	123.09	13.97	238.63	54.96	244.87	170.91	87.21
260	32° 30′	42° 15.0′	127.68	15.67	246.21	61.47	253.77	178.54	91.42
270	33° 45′	45° 33.8′	132.20	17.49	253.42	68.40	262.49	186.35	95.80
280	35° 00′	49° 00.0′	136.66	19.44	260.20	75.75	271.00	194.36	100.36

THE STANDARD HIGHWAY SPIRAL

$a = 15.0$

L	D	S	q	p	Y	X	C	U	V
10	1° 30′	0° 04.5′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	3° 00′	0° 18.0′	10.00	0.01	20.00	0.03	20.00	13.33	6.67
30	4° 30′	0° 40.5′	15.00	0.03	30.00	0.12	30.00	20.00	10.00
40	6° 00′	1° 12.0′	20.00	0.07	40.00	0.28	40.00	26.67	13.33
50	7° 30′	1° 52.5′	25.00	0.14	49.99	0.54	50.00	33.33	16.67
60	9° 00′	2° 42.0′	30.00	0.24	59.99	0.94	59.99	40.00	20.00
70	10° 30′	3° 40.5′	35.00	0.37	69.97	1.50	69.99	46.68	23.34
80	12° 00′	4° 48.0′	39.98	0.56	79.94	2.23	79.98	53.35	26.68
90	13° 30′	6° 04.5′	44.98	0.80	89.90	3.18	89.96	60.04	30.03
100	15° 00′	7° 30.0′	49.97	1.09	99.83	4.36	99.92	66.73	33.39
110	16° 30′	9° 04.5′	54.95	1.45	109.72	5.80	109.88	73.43	36.76
120	18° 00′	10° 48.0′	59.93	1.88	119.57	7.52	119.81	80.15	40.14
130	19° 30′	12° 40.5′	64.89	2.39	129.37	9.55	129.72	86.89	43.54
140	21° 00′	14° 42.0′	69.85	2.99	139.08	11.92	139.59	93.66	46.96
150	22° 30′	16° 52.5′	74.78	3.67	148.70	14.64	149.42	100.46	50.42
160	24° 00′	19° 12.0′	79.70	4.45	158.21	17.73	159.20	107.30	53.91
170	25° 30′	21° 40.5′	84.59	5.33	167.58	21.22	168.92	114.19	57.45
180	27° 00′	24° 18.0′	89.46	6.32	176.79	25.12	178.57	121.15	61.05
190	28° 30′	27° 04.5′	94.30	7.42	185.80	29.45	188.12	128.18	64.71
200	30° 00′	30° 00.0′	99.09	8.64	194.59	34.23	197.57	135.30	68.46
210	31° 30′	33° 04.5′	103.84	9.98	203.11	39.46	206.91	142.52	72.30
220	33° 00′	36° 18.0′	108.54	11.45	211.33	45.15	216.10	149.87	76.26
230	34° 30′	39° 40.5′	113.19	13.05	219.21	51.30	225.14	157.37	80.35
240	36° 00′	43° 12.0′	117.76	14.78	226.71	57.91	234.00	165.04	84.60
250	37° 30′	46° 52.5′	122.26	16.64	233.78	64.99	242.64	172.91	89.04

THE STANDARD HIGHWAY SPIRAL

$a = 20.0$

L	D	S	q	p	Y	X	C	U	V
10	2°	0° 06′	5.00	0.00	10.00	0.01	10.00	6.67	3.33
20	4°	0° 24′	10.00	0.01	20.00	0.05	20.00	13.33	6.67
30	6°	0° 54′	15.00	0.04	30.00	0.16	30.00	20.00	10.00
40	8°	1° 36′	20.00	0.09	40.00	0.37	40.00	26.67	13.33
50	10°	2° 30′	25.00	0.18	49.99	0.73	50.00	33.34	16.67
60	12°	3° 36′	30.00	0.31	59.98	1.26	59.99	40.01	20.01
70	14°	4° 54′	34.99	0.50	69.95	1.99	69.98	46.68	23.35
80	16°	6° 24′	39.98	0.74	79.90	2.98	79.96	53.37	26.70
90	18°	8° 06′	44.97	1.06	89.82	4.24	89.92	60.06	30.06
100	20°	10° 00′	49.95	1.45	99.70	5.81	99.86	66.77	33.43
110	22°	12° 06′	54.92	1.93	109.51	7.72	109.78	73.51	36.82
120	24°	14° 24′	59.87	2.51	119.24	10.01	119.66	80.27	40.24
130	26°	16° 54′	64.81	3.19	128.87	12.70	129.50	87.06	43.69
140	28°	19° 36′	69.73	3.97	138.37	15.83	139.27	93.91	47.19
150	30°	22° 30′	74.62	4.88	147.70	19.42	148.97	100.82	50.75
160	32°	25° 36′	79.47	5.92	156.84	23.49	158.58	107.80	54.37
170	34°	28° 54′	84.28	7.08	165.73	28.07	168.08	114.88	58.08
180	36°	32° 24′	89.05	8.39	174.33	33.16	177.45	122.07	61.89
190	38°	36° 06′	93.76	9.84	182.59	38.79	186.67	129.40	65.83
200	40°	40° 00′	98.40	11.44	190.47	44.95	195.70	136.90	69.92
210	42°	44° 06′	102.96	13.19	197.90	51.64	204.52	144.61	74.21
220	44°	48° 24′	107.43	15.10	204.81	58.86	213.10	152.55	78.71

THE STANDARD HIGHWAY SPIRAL

a = 25.0

L	D	S	q	p	Y	X	C	U	V
10	2° 30′	0° 07.5′	5.00	0.00	10.00	0.01	10.00	6.67	3.33
20	5° 00′	0° 30.0′	10.00	0.01	20.00	0.06	20.00	13.33	6.67
30	7° 30′	1° 07.5′	15.00	0.05	30.00	0.20	30.00	20.00	10.00
40	10° 00′	2° 00.0′	20.00	0.12	40.00	0.47	40.00	26.67	13.33
50	12° 30′	3° 07.5′	25.00	0.23	49.99	0.91	49.99	33.34	16.67
60	15° 00′	4° 30.0′	29.99	0.39	59.96	1.57	59.98	40.01	20.01
70	17° 30′	6° 07.5′	34.99	0.62	69.92	2.49	69.96	46.69	23.36
80	20° 00′	8° 00.0′	39.97	0.93	79.84	3.72	79.93	53.39	26.72
90	22° 30′	10° 07.5′	44.95	1.32	89.72	5.29	89.88	60.10	30.09
100	25° 00′	12° 30.0′	49.92	1.81	99.53	7.25	99.79	66.83	33.48
110	27° 30′	15° 07.5′	54.87	2.41	109.24	9.63	109.66	73.60	36.91
120	30° 00′	18° 00.0′	59.80	3.13	118.82	12.48	119.47	80.42	40.33
130	32° 30′	21° 07.5′	64.71	3.98	128.24	15.82	129.22	87.29	43.90
140	35° 00′	24° 30.0′	69.58	4.96	137.46	19.69	138.87	94.24	47.49
150	37° 30′	28° 07.5′	74.40	6.08	146.43	24.12	148.40	101.29	51.18
160	40° 00′	32° 00.0′	79.18	7.36	155.08	29.13	157.79	108.46	54.97
170	42° 30′	36° 07.5′	83.89	8.81	163.36	34.73	167.02	115.79	58.90
180	45° 00′	40° 30.0′	88.52	10.42	171.21	40.92	176.04	123.30	63.01
190	47° 30′	45° 07.5′	93.07	12.20	178.55	47.71	184.81	131.04	67.33
200	50° 00′	50° 00.0′	97.51	14.16	185.30	55.09	193.31	139.07	71.91

Spiral Problems

TYPICAL SOLUTION OF SPIRAL ELEMENTS AND DEFLECTION ANGLES

(Curve with spirals of equal length)

EXAMPLE I

Given:

$D = 6°$

$\Delta = 45°$

$L = 400'$

Station of P. S. $= 321 + 11.5$

To find elements of spiral and main curve and to determine deflection angles from P. S. to points on the spiral.

$$a = \frac{100\,D}{L} = \frac{600}{400} = 1.5$$

$$S = \frac{D\,L}{200} = \frac{6 \times 400}{200} = 12°$$

$i = \frac{1}{3}\,S - n = 3°\ 59'\ 55''$ (Table IV) or
$4°$ for practical purposes

From Table IV

$C = .998052 \times 400 = 399.22'$
$Y = .995622 \times 400 = 398.25'$
$X = .069595 \times 400 = 27.84'$
$U = .668205 \times 400 = 267.28'$
$V = .334732 \times 400 = 133.89'$
$p = .017426 \times 400 = 6.97'$
$q = .499270 \times 400 = 199.71'$

DEFLECTION ANGLES TO POINTS ON SPIRAL

P. S. to Station	Distance Feet	Defl. Min. (Table II)		a		Deflection Angle
321 + 50	38.5	1.48 Min.	×	1.5	=	0° 02.2′
322	88.5	7.83 Min.	×	1.5	=	0° 11.7′
+ 50	138.5	19.18 Min.	×	1.5	=	0° 28.8′
323	188.5	35.53 Min.	×	1.5	=	0° 53.3′
+ 50	238.5	56.88 Min.	×	1.5	=	1° 25.3′
324	288.5	83.23 Min.	×	1.5	=	2° 04.8′
+ 50	338.5	114.57 Min.	×	1.5	=	2° 51.9′
325	388.5	150.91 Min.	×	1.5	=	3° 46.4′
+ 11.5 (P.S.C.)	400.0	159.97 Min.	×	1.5	=	4° 00.0′

Set up on P. S. C. and turn tangent by turning 8° from P. S.

Then from Table I—deflection angles for 6° curve.

P. S. C. to Station	Distance Feet		Defl. per Ft. Min.		Deflection Angle
325 + 50	38.5	×	1.8	=	1° 09.3′
326	88.5	×	1.8	=	2° 39.3′

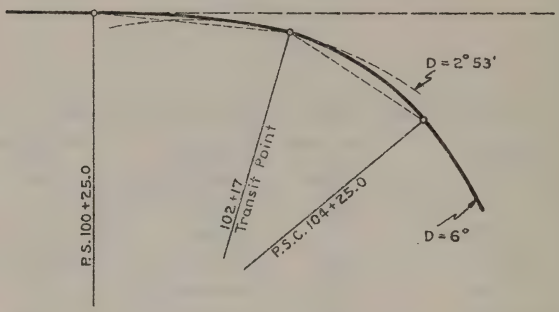
SOLUTION OF SEMI-TANGENT Ts

$$Ts = q + (R + p)\ \text{Tan}\ \frac{\Delta}{2}$$

$$= 199.71 + (954.93 + 6.97)\ \ .4142136$$
$$= 598.14$$

INTERMEDIATE SETUP ON SPIRAL WITH DEFLECTIONS

EXAMPLE II



Given:

S = 12° 00′
D = 6° 00′
a = 1.5
L = 400′
P. S. = 100 + 25.0
P. S. C. = 104 + 25.0

Assume it is necessary to make intermediate setup at Station 102 + 17.

Rule: A spiral deviates from the simple curve common to it at any point at the same rate as it deviates from the tangent at the P. S. Therefore, at any point on the spiral the deflection angle from the tangent at that point to any other point on the spiral is equal to the deflection angle for a simple curve of the same degree as the spiral at the intermediate setup plus or minus the deflection from tangent at the P. S. to a point at an equivalent distance from the P. S. thus:

Station	Simple Curve Deflection (D = 2° 53′)*		Spiral Deflection Table II		Deflection (Instr. at Sta. 102 +17)*
PS 100 + 25.0	2° 45.9′	—	0° 55.3′	=	1° 50.6′
+ 50	2° 24.3′	—	0° 41.8′	=	1° 42.5′
101	1° 41.1′	—	0° 20.5′	=	1° 20.6′
+ 50	0° 57.9′	—	0° 06.7′	=	0° 51.2′
102	0° 14.7′	—	0° 00.4′	=	0° 14.3′
Transit Point + 17	0° 00.0′		0° 00.0′		0° 00.0′
+ 50	0° 28.5′	+	0° 01.6′	=	0° 30.1′
103	1° 11.7′	+	0° 10.3′	=	1° 22.0′
+ 50	1° 54.9′	+	0° 26.5′	=	2° 21.4′
104	2° 38.1′	+	0° 50.2′	=	3° 28.3′
PSC + 25	2° 59.7′	+	1° 04.9′	=	4° 04.6′

* Degree of curve at point of intermediate setup

$$\text{Sta. } 102 + 17 = \frac{192}{400} \times 6° 00′ = 2° 52.8′$$

DEFLECTIONS TO SPIRAL FROM P. S. C. OR P. C. S.

EXAMPLE III.

Given:

L = 400′

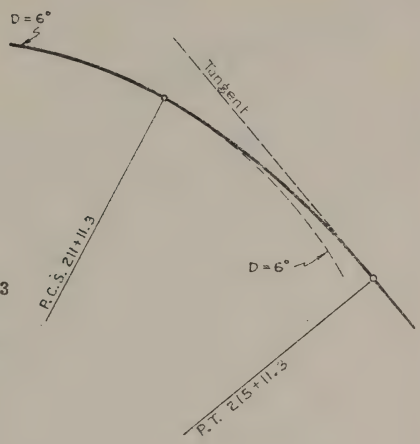
S = 12° 00′

D = 6° 00′

a = 1.5

P. C. S. 211 + 11.3

P. T. 215 + 11.3



To back the spiral in from P. C. S.

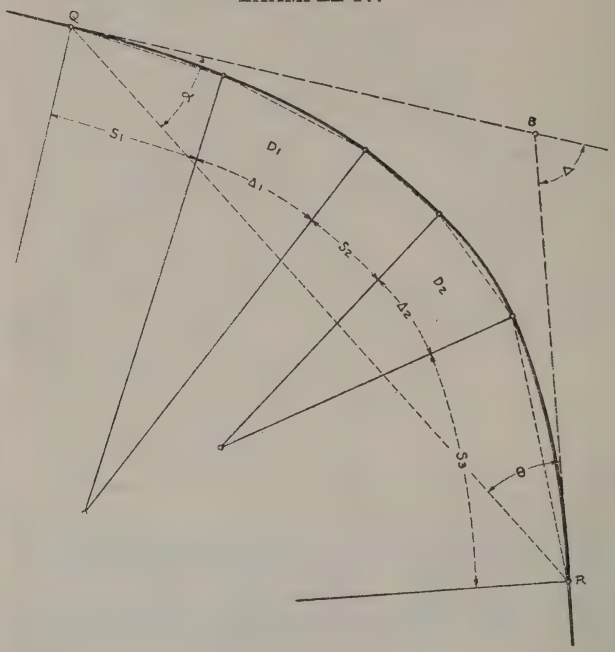
Rule: A spiral curve and a simple curve which coincide at any point (as at the P. C. S.) deviate from each other at the same rate as the spiral does from the tangent at the P. S.

Therefore, to obtain deflection angles from the tangent to the curve at the P. C. S. to the spiral, compute deflection angles to the simple curve and subtract therefrom the deflection angles to the spiral at corresponding distances from the P. S.

Station		Simple Curve Deflec-toin (D = 6°)		Spiral Deflec-tion Table II		Deflec-tions (Instr. at P. C. S.)
P. C. S.	211 + 11.3	0° 00.0′	—	0° 00.0′	=	0° 00.0′
	+ 50	1° 09.7′	—	0° 02.2′	=	1° 07.5′
	+ 75	1° 54.7′	—	0° 06.1′	=	1° 48.6′
	212	2° 39.7′	—	0° 11.8′	=	2° 27.9′
	+ 35	3° 42.7′	—	0° 23.0′	=	3° 19.7′
	+ 80	5° 03.7′	—	0° 42.7′	=	4° 21.0′
	213 + 20	6° 15.7′	—	1° 05.3′	=	5° 10.4′
	+ 50	7° 09.7′	—	1° 25.5′	=	5° 44.2′
	214	8° 39.7′	—	2° 05.0′	=	6° 34.7′
	+ 50	10° 09.7′	—	2° 52.1′	=	7° 17.6′
	215	11° 39.7′	—	3° 46.6′	=	7° 53.1′
	+ 11.3	12° 00.0′	—	4° 00.0′	=	8° 00.0′

METHOD OF FITTING A SPIRAL BETWEEN TWO PARTS OF A COMPOUND CURVE WITH SPIRAL TRANSITIONS AT EACH END

EXAMPLE IV.



Given:

Δ
D_1
D_2

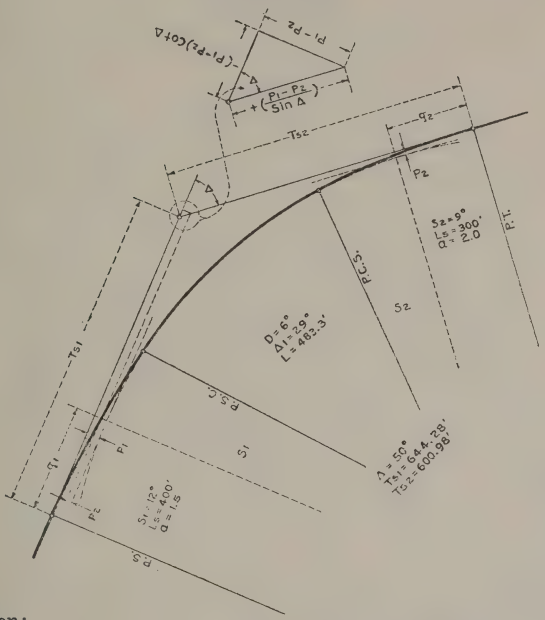
Ls_1, Ls_2, and Ls_3 (Spiral lengths)

To find Semi-tangents:

(1) Ascertain Δ_1 (by assumption or measurement).
(2) Then $\Delta_2 = \Delta - \Delta_1, -S_1, -S_2, -S_3$.
(3) Find long chords for simple curves and spirals.
(4) Figure bearings for chords.
(5) Compute coordinates for point "R".
(6) Compute length and bearing of long chord Q-R.
(7) Then $\theta = \Delta - \propto$;
(8) Solve triangle QBR for semi-tangents QB and BR. (Three angles and one side known.)
(9) Spiral S_2 may be used to connect curves D_1 and D_2 by choosing that portion of the spiral having curvature intermediate between the degree of the two simple curves; thus if $D_1 = 3°$ and $D_2 = 10°$ the connecting spiral will vary from 3° to 10° omitting the portion of the spiral below 3°. Deflection angles from P. C. S. or P. S. C. may be computed in the same manner as for an intermediate setup on the spiral (see Example II).

METHOD OF COMPUTING SEMI-TANGENTS FOR CURVES WITH SPIRALS OF UNEQUAL LENGTH

EXAMPLE V.



Given:

$Ls_1 = 400'$
$Ls_2 = 300'$
$D = 6°\ 00'$
$\Delta = 50°\ 00'$

To compute Semi-tangents ascertain the spiral elements from the tables as in Example I.
Then

$$Ts_1 = q_1 + (R + p_2)\ \text{Tan}\ \frac{\Delta}{2} - (p_1 - p_2)\ \text{Cot}\ \Delta$$

$$Ts_2 = q_2 + (R + p_2)\ \text{Tan}\ \frac{\Delta}{2} + \frac{p_1 - p_2}{\text{Sin}\ \Delta}$$

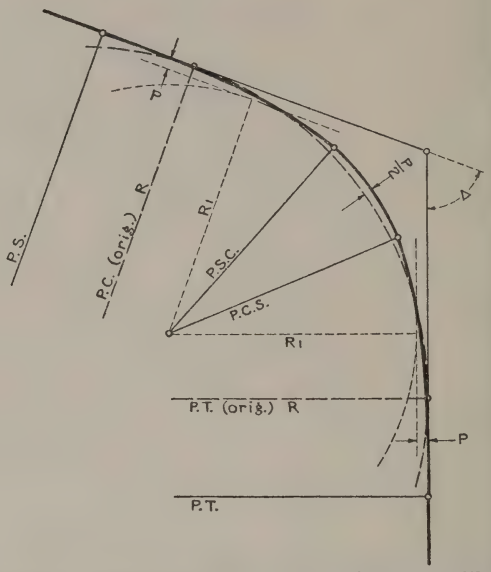
$$Ts_1 = 199.71 + (954.93 + 3.92) \times .4663077 - (6.97 - 3.92)\ .8390996 = 644.27$$

$$Ts_2 = 149.88 + (954.93 + 3.92) \times .4663077 + \frac{6.97 - 3.92}{.7660444} = 600.98$$

Rule: Ls_1 = Longer Spiral

METHOD OF FITTING EXISTING SIMPLE CURVE ALIGNMENT WITH SPIRALED CURVES REQUIRING A MINIMUM SHIFT OF ALIGNMENT

EXAMPLE VI.



Given:

D

R

Δ

Ls

Find: D_1

To retain present tangents and fit spiraled alignment with least possible shift of simple curve.

The new curve will be sharper and it should lay outside of the old curve at the vertex, and the distance between the vertexes of the two curves should be equal to half the spiral offsets, $\frac{p}{2}$.

$$\text{Then } R_1 = R - \frac{p + \frac{p}{2}\cos\frac{\Delta}{2}}{1 - \cos\frac{\Delta}{2}}$$

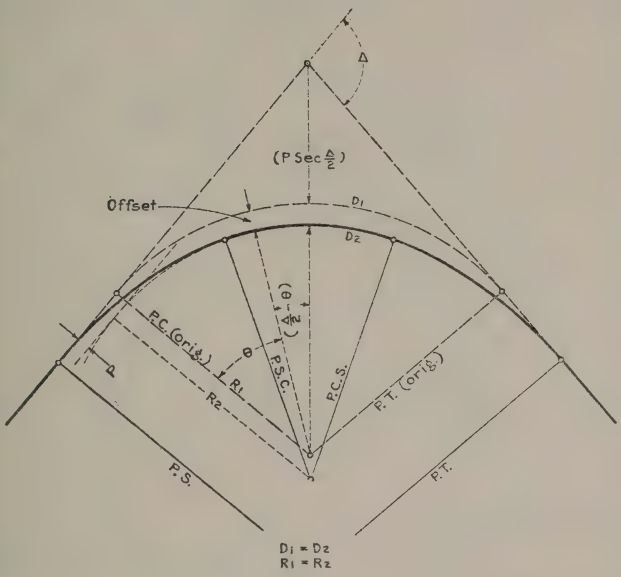
In solving this equation, a value of "p" must be assumed. This value will be slightly greater than the value of "p" for a degree of curve equal to the original curve. The assumption should be based on an estimate of the new degree of curve required.

Then revise the value of "p" to fit alignment.

$$D_1 = \frac{5729.578}{R_1}$$

OFFSETS FROM SIMPLE CURVE ALIGNMENT TO SPIRALED ALIGNMENT USING SAME DEGREE OF CURVE AND ORIGINAL TANGENTS

EXAMPLE VII.

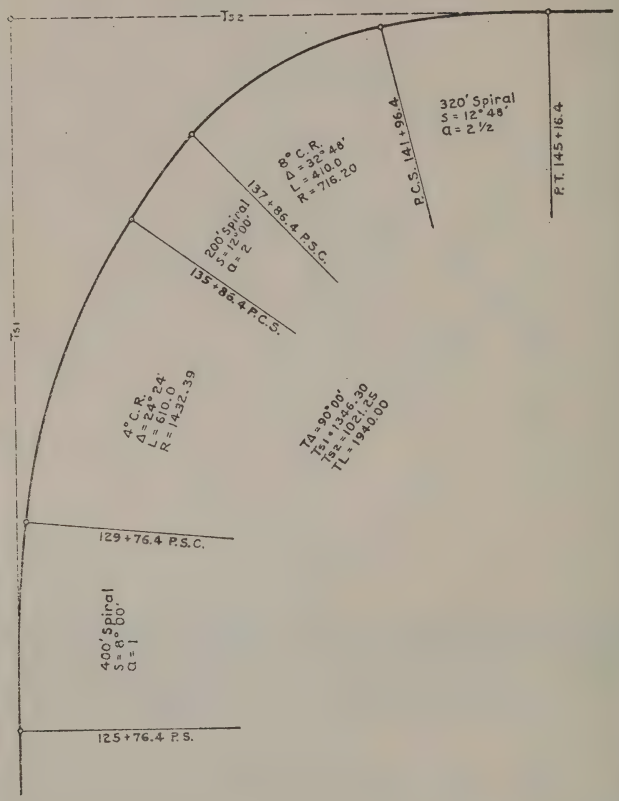


In fitting spiraled alignment to existing simple curve alignment, retaining the same degree of main curve and the original tangents, it will be found that the new main curve is neither concentric with nor parallel to the original curve. The offset varies from a value of "p" as shown on the sketch to a value of (p Sec $\frac{\Delta}{2}$) at the vertex. Between the point where the value of "p" applies to the P. S. C. the offsets from the original alignment to the new alignment may be found by obtaining the X coordinate to the point in question on the spiral and making correction for the offset to the original simple curve where that is necessary. Beyond the P. S. C. the following approximate formula will give values of the offset sufficiently close for practical purposes.

$$\text{Offset} = \text{p Sec } \frac{\Delta}{2}\left[\cos\left(\frac{\Delta}{2} - \theta\right)\right] \text{ Approximately}$$

Where θ = angle from the P. C. or P. T. of original simple curve to the point desired.

EXAMPLE VIII.

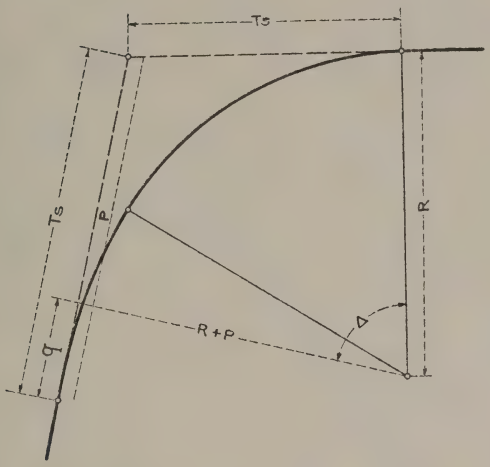


STANDARD METHOD OF SHOWING ALIGNMENT ON MAPS

Stationing to be shown to the nearest tenth of a foot.
Angles and Bearings shown to the nearest half Minute.

METHOD OF COMPUTING SEMI-TANGENTS OF CURVE WITH SPIRAL AT ONE END ONLY

EXAMPLE IX.



When Δ is less than 90°

$$Ts = \frac{(R + p) - (R \text{ Cos } \Delta)}{\text{Sine } \Delta}$$

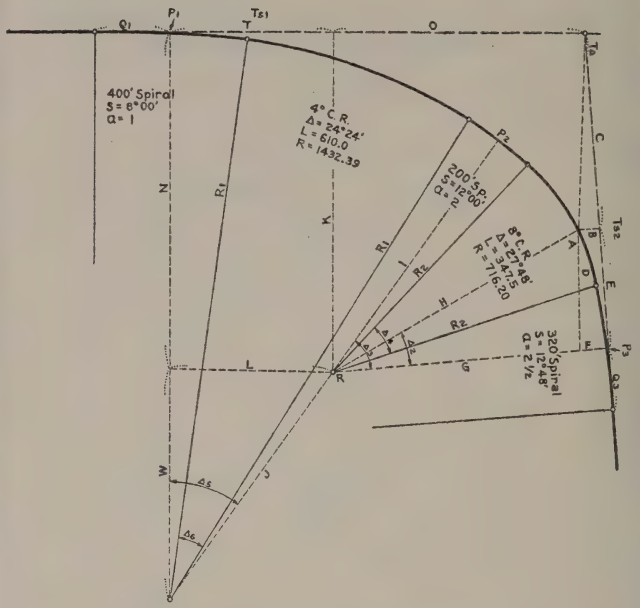
$$Ts_1 = \frac{R - (R + p) \text{ Cos } \Delta}{\text{Sine } \Delta} + q$$

When Δ is over 90°

$$Ts = \frac{(R + p) + (R \text{ Cos } \Delta)}{\text{Sine } \Delta}$$

$$Ts_1 = \frac{R + (R + p) \text{ Cos } \Delta}{\text{Sine } \Delta} + q$$

EXAMPLE X



COMPOUND CURVE WITH THREE SPIRALS

With a given or assumed semi-tangent or a fixed pass through point. Total angle and radii of both curves known.

In case of fixed pass through point, to find Ts_2: Assume Ts_1 as the basis of co-ordinates with the P. I. as the origin of co-ordinates calculate from known ties the co-ordinates of pass through point. From co-ordinates calculate C and B. Then

$B = F$, $G = (R_2 + p_3) - F$, $H = R_2$, cosine $\Delta_2 = \frac{G}{H}$, $D = H$ sine Δ_2, $E = D$ and $Ts_2 = C + E + Q_3$.

Having fixed or assumed Ts_2, to find Ts_1, and Δ of curves: Calculate co-ordinates of radius point "R". Then K = departure of R and O = latitude of R. p_2 is the p distance for a spiral for a curve whose degree is $D_2 - D_1$. Then $I = R_2 + p_2$.

$J = R_1 - I$, $K = N$, $M = (R_1 + p_1) - N$, cosine $\Delta_5 = \frac{M}{J}$, $L = J$ sine Δ_5, $T = L$, $\Delta_6 = \Delta_5 - (S_1 + \Delta$ for D_1 for ½ length of intermediate Spiral), $\Delta_3 = T\Delta - \Delta_5$, $\Delta_4 = \Delta_3 - (S_3 + \Delta$ for D_2 for ½ length of intermediate spiral) $Ts_1 = O + T + Q_1$.